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OCS Report
MMS 90-0082

Outer Continental Shelf

Estimated Oil and Gas Reserves, Gulf of Mexico, December 31, 1989

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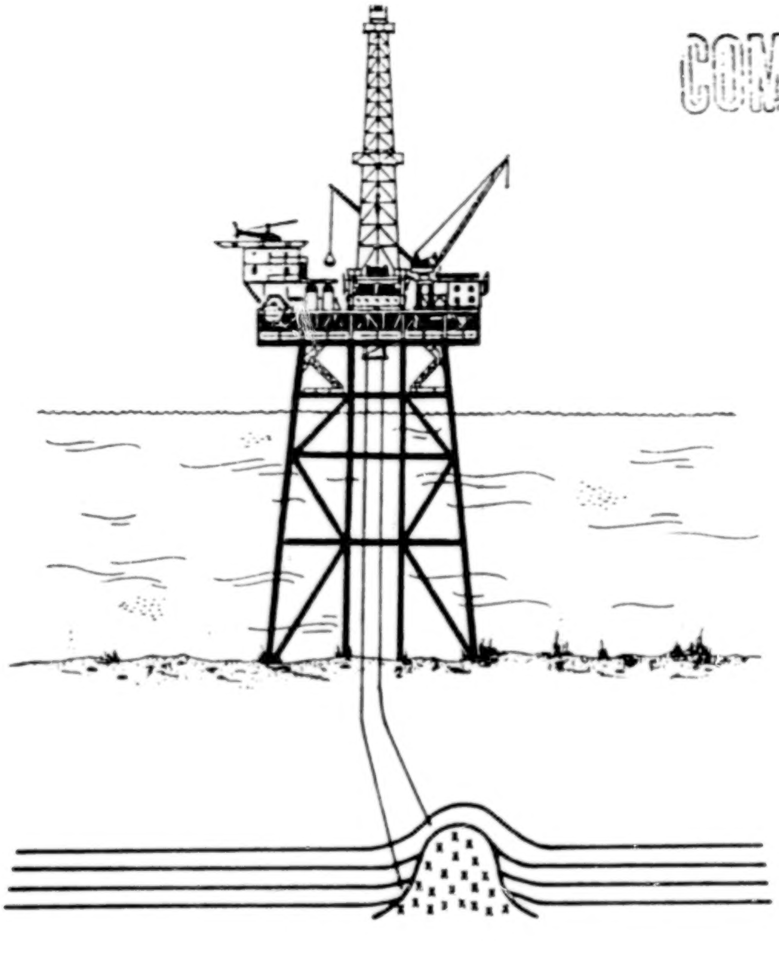

U.S. Department of the Interior
MMS Minerals Management Service
Gulf of Mexico OCS Region

Technical Announcement

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

Estimated Oil and Gas Reserves Gulf of Mexico Outer Continental Shelf December 31, 1989

OCS Report MMS 90-0082

by J. Melancon, J. Brooke, C. Kinler, and J. Knipmeyer

As of December 31, 1989, about 3.03 billion barrels of petroleum liquids (both oil and natural gas condensate) and about 40.2 trillion cubic feet of natural gas are estimated to exist as "remaining recoverable reserves" in 682 proved fields of the Gulf of Mexico Outer Continental Shelf, according to a Minerals Management Service report. The report indicates a decrease of about 0.36 billion barrels of liquid (oil and gas condensate) and a decrease of 2.2 trillion cubic feet of gas in remaining recoverable reserves as compared to the December 31, 1988, estimates. New field discoveries account for an increase of 0.16 billion barrels of liquid and 2.9 trillion cubic feet of gas.

Original recoverable reserves are estimated to have been 10.87 billion barrels of oil and 129.1 trillion cubic feet of gas from 739 proved fields under the Federal submerged lands in the Gulf of Mexico. Included in this number are 57 fields that are depleted and abandoned; not included are 114 new fields not sufficiently developed to be classified as containing proved reserves. As of December 31, 1989, cumulative production from these 739 fields was 7.84 billion barrels of oil and 88.9 trillion cubic feet of gas.

The 56-page report *Estimated Oil and Gas Reserves Gulf of Mexico Outer Continental Shelf December 31, 1989*, MMS Technical Report 90-0082, was prepared by J. Michael Melancon, Jeff P. Brooke, Clark J. Kinler, and John H. Knipmeyer. Copies are available from MMS at a cost of $3.00 each. Checks should be made payable to the Minerals Management Service and orders should be sent to

Minerals Management Service
Gulf of Mexico OCS Region
Public Information Unit MS 5034
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The report will also be available from the National Technical Information Service shortly.

October 1990

OCS Report
MMS 90-0082

Outer Continental Shelf

Estimated Oil and Gas Reserves, Gulf of Mexico, December 31, 1989

J. Michael Melancon
Jeff P. Brooke
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Reserves Section

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office

New Orleans
October 1990

FOREWORD

The Minerals Management Service conducts studies of proved oil and gas reserves of fields in the Federal Outer Continental Shelf (OCS) of the United States. Currently, two separate reports, one for the Pacific OCS and the other for the Gulf of Mexico (GOM) OCS, are published annually. This report, covering the GOM OCS, contains the original and remaining recoverable reserves, annual and cumulative production, and spatial and temporal distribution of reservoirs. It is of interest to note that 72 percent of the original recoverable oil reserves and 69 percent of the original recoverable gas reserves for the GOM OCS have already been produced. Also, new field discoveries have demonstrated a trend toward decreasing average size over the last 25 years. The importance of the need for more exploration and resulting discoveries cannot be overstated in trying to meet this Nation's future energy needs.

A significant portion (70 percent measured in barrels of oil equivalent) of the remaining recoverable reserves in the GOM OCS consists of natural gas. As the environmental consciousness of the Nation rises and traditional supplies of oil either decline or become less reliable, natural gas will become of increasingly greater importance. Currently, the GOM OCS accounts for more than 1/4 of the total domestic U.S. natural gas production.

I hope this report will be helpful to the public, the oil and gas industry, and other Government Agencies engaged or interested in oil and gas activities of the OCS and analyses of domestic supplies.

Barry Williamson

Barry A. Williamson
Director
Minerals Management Service

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Abstract

Remaining recoverable reserves of oil* and gas in the Gulf of Mexico Outer Continental Shelf (OCS) have been estimated to be 3.03 billion barrels of oil and 40.2 trillion cubic feet of gas, as of December 31, 1989. These reserves are recoverable from 682 proved fields located in Federal waters.

For any field contained partly in State waters and partly in Federal waters, reserves are estimated for the Federal portion only. An additional 114 fields have not been sufficiently developed to permit a reasonably accurate estimate of reserves.

Original recoverable reserves are estimated to have been 10.87 billion barrels of oil and 129.1 trillion cubic feet of gas from 739 proved fields in the same geographic area. Included in this number are 57 fields that are depleted and abandoned; not included are the 114 insufficiently developed fields. Estimates were made for individual reservoirs based on geologic mapping and reserve evaluation of 522 fields. Preliminary geologic studies were conducted for the remaining 217 fields.

---

*The term "oil" as used in this report includes crude oil and condensate.

Introduction

This report, which supersedes Minerals Management Service (MMS) OCS Report MMS 89-0074 (Melancon and others, 1989), presents estimates of original recoverable reserves, cumulative production, and estimates of remaining recoverable reserves as of December 31, 1989, for the Gulf of Mexico (GOM). The estimates of reserves for this report were completed in May 1990 and represent the combined efforts of engineers, geologists, geophysicists, paleontologists, and other personnel of the MMS Gulf of Mexico Outer Continental Shelf (OCS) Regional Office in New Orleans, Louisiana.

As in previous reports (for example, Bryan and others, 1978), standard methods of estimating reserves were used, including volumetric calculation, decline curve analysis, material balance, and mathematical simulation.

Definition of Reserve and Resource Terms

The MMS Gulf of Mexico OCS Regional office has modified its definitions concerning resources to reflect those of the U.S. Geological Survey and the Minerals Management Service (1989) and its definitions concerning reserves to reflect those of the Society of Petroleum Engineers (1987). These changes, effective in 1988, are represented in figures 1 and 2.

Undiscovered Resources Resources, estimated from broad geologic knowledge and theory, existing outside of known fields or known accumulations are *undiscovered resources.* Undiscovered resources can exist in untested prospects — unleased acreage and undrilled leased acreage — or in known fields, where undiscovered resources occur in undiscovered pools that exist as unrelated accumulations controlled by distinctly separate structural features or stratigraphic conditions (*Estimates of Undiscovered Conventional Oil and Gas Resources in the United States, A Summary*).

Discovered Resources Once leased acreage is drilled and qualifies under Title 30 Code of Federal Regulations (CFR) Part 250, Subpart A, Section 11, Determination of Well Producibility, the lease is considered to have *discovered resources.* Discovered resources are the equivalent of identified resources as reported by Dolton and others (1981, p. 6-7). Identified resources are resources whose location and quantity are known or are estimated from specific geologic evidence and that include economic, marginally economic, and

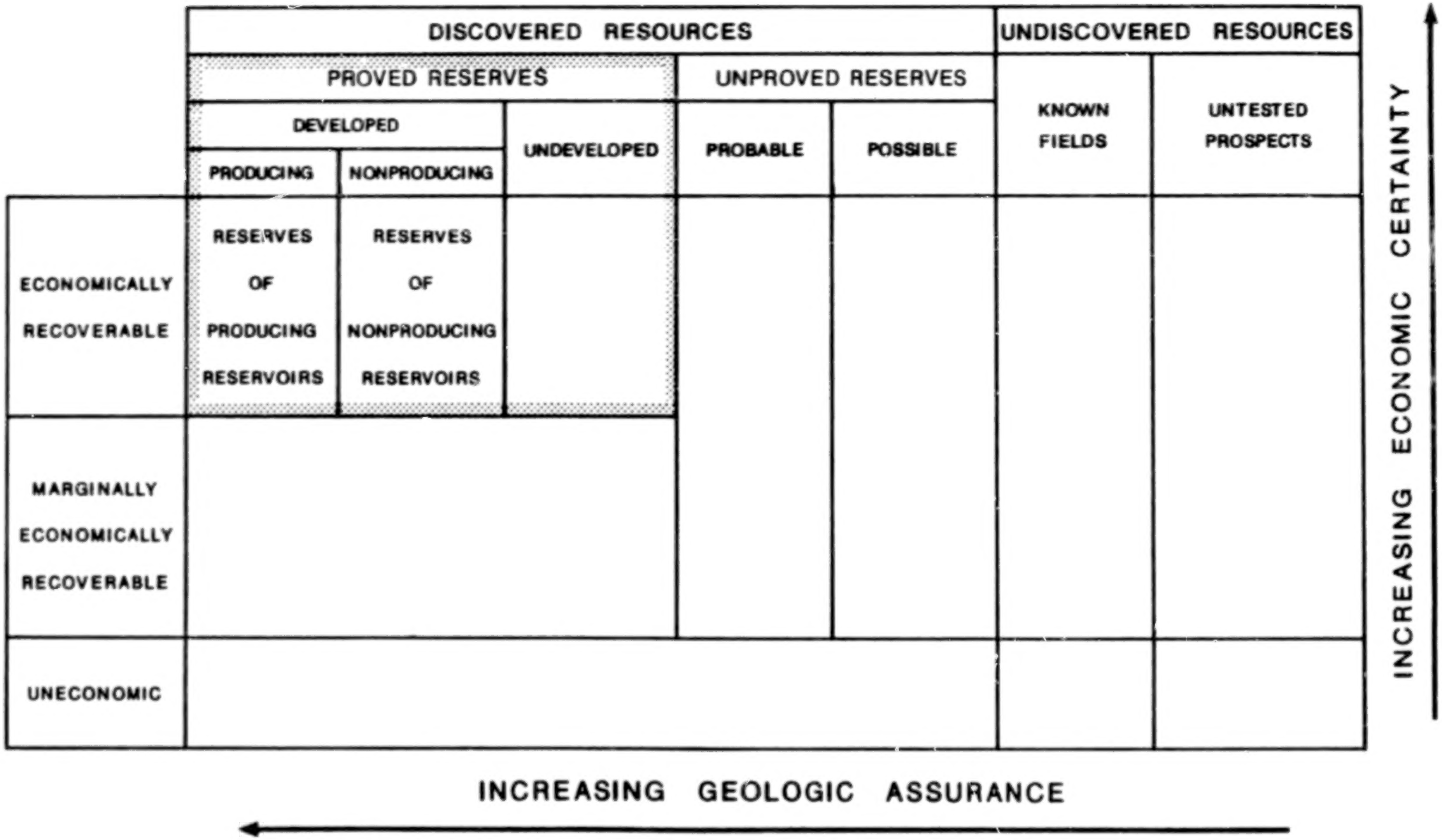
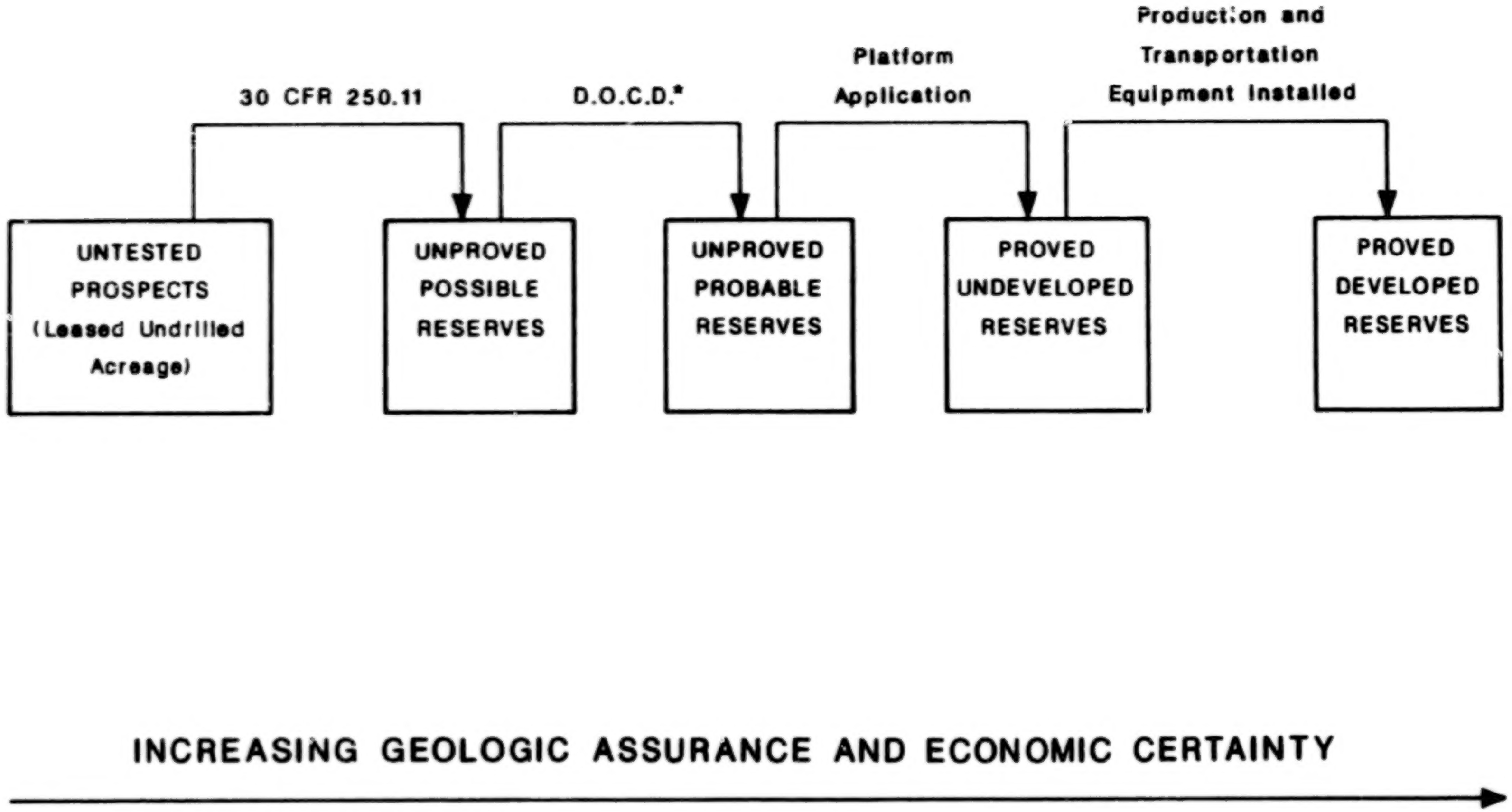


Figure 1.—MMS petroleum resource classification (modified from USGS, 1982, and SPE, 1987).


Production and Transportation Equipment Installed
Platform Application
30 CFR 250.11
D.O.C.D.*
UNTESTED PROSPECTS (Leased Undrilled Acreage)
UNPROVED POSSIBLE RESERVES
UNPROVED PROBABLE RESERVES
PROVED UNDEVELOPED RESERVES
PROVED DEVELOPED RESERVES
INCREASING GEOLOGIC ASSURANCE AND ECONOMIC CERTAINTY

*Development Operations Coordination Document

Figure 2.—Gulf of Mexico MMS reserves classification procedure.

subeconomic components. Discovered resources can be further characterized as unproved or proved reserves depending upon the evidence of economic accumulations.

Unproved Reserves

After a lease qualifies under 30 CFR 250.11, the MMS Gulf of Mexico Regional Field Names Committee reviews the new producible lease to place the lease in an existing field or, if the lease is not associated with an established geologic structure, a new field. Regardless of whether the lease is assigned to an existing field or to a new field, the reserves associated with the lease are initially considered *unproved reserves*. Unproved reserves are based on geologic and/or engineering data similar to that used in estimates of proved reserves, but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved.

Unproved reserves are not to be added to proved reserves because of different levels of uncertainty. For purposes of this publication, only proved reserves as highlighted in figure 1 will be reported. Unproved reserves may be divided into two subclassifications, possible and probable, which are again based upon the level of uncertainty.

Unproved possible reserves are less certain than unproved probable reserves and can be estimated with a low degree of certainty, which is insufficient to indicate whether they are more likely to be recovered than not. Reservoir characteristics are such that a reasonable doubt exists that the project will be commercial (SPE, 1987). After a lease qualifies under 30 CFR 250.11, the reserves associated with the lease are initially classified as unproved possible because the only direct evidence of economic accumulations is a production test or electric log analysis.

Unproved probable reserves are less certain than proved reserves and can be estimated with a degree of certainty sufficient to indicate they are more likely to be recovered than not (SPE, 1987). Fields that have a significant, recent producible discovery or that have a Development Operations Coordination Document (DOCD) on file with MMS would be classified as unproved probable.

Proved Reserves

Proved reserves can be estimated with reasonable certainty to be recovered under current economic conditions. Current economic conditions include prices and costs prevailing at the time of the estimate. Proved reserves must either have facilities that are operational at the time of the estimate to process and transport those reserves to market, or a commitment or reasonable expectation to install such facilities in the future (SPE, 1987). The application for a permit to install a platform is considered such a commitment. Proved reserves can be subdivided into undeveloped and developed.

Proved undeveloped reserves exist where there is a relatively large expenditure required to install production and/or transportation facilities, a commitment by the operator is made, and a time frame to begin production is established. Proved undeveloped reserves are reserves expected to be recovered from yet undrilled wells or from existing wells where a relatively large expenditure is required for recompletion.

Proved Developed Reserves. Reserves that are expected to be recovered from existing wells (including reserves behind pipe) are classified as *proved developed reserves.* Reserves are considered developed only after the necessary production and transportation equipment has been installed, or when the costs to do so are relatively minor. Proved developed reserves are subcategorized as producing or nonproducing (SPE, 1987). This distinction is made at the reservoir level and not the field level.

Proved Developed Producing. Once the first reservoir in a field begins production, the reservoir is considered *proved developed producing*, and the field is considered on production. If a reservoir has produced any time during the 12 months before the reporting date, it is considered proved developed producing.

Proved Developed Nonproducing. Any developed field that has not produced during the 12 months prior to the reporting date is considered *proved developed nonproducing.* This category includes off-production reservoirs behind pipe and reservoirs awaiting workovers or transportation facilities.

Production data are the metered volumes of raw liquids and gas reported to the MMS by Federal lessees and operators. Oil volume measurements and reserves are corrected to reference standard conditions of 60 °F and one atmosphere (14.696 pounds per square inch absolute [psia]); gas measurements and reserves are corrected to 60 °F and 15.025 psia. To convert gas volumes to 14.696 psia, multiply by 1.022. Continuously measured volumes from production platforms and/or leases are allocated to individual wells and reservoirs on the basis of periodic well test *gauges*. These procedures introduce approximations in both production and reserves data by reservoirs and by fields.

Reserves and Related Data Reported by Area

The Gulf of Mexico has been divided into three planning areas for administrative purposes; these planning areas (Western, Central, and Eastern) are shown in figures 3, 4, and 5, respectively. Each planning area is subdivided into smaller areas, which in turn are divided into numbered blocks. Fields in the Gulf of Mexico are identified by the smaller area name and block number of discovery — for example, East Cameron Block 271 Field. As the field is developed, the limits often expand into adjacent blocks and areas. These adjacent blocks are then identified as being part of the original field and are given that field name. Statistics in this report are presented as area totals compiled under each field name. All of the data associated with East Cameron Block 271 Field are therefore included in the East Cameron totals, even though part of the field extends into the adjacent area of Vermilion. There are four exceptions to the above field-naming techniques. These four fields and the area totals in which the field data are included are Tiger Shoal and Lighthouse Point, included in South Marsh Island; Coon Point, included in Ship Shoal; and Bay Marchand, included in South Timbalier.

Within the last year the first and only proved field has been identified in the Eastern Planning Area. To protect the confidentiality of its location the reserves are reported in the Central Planning Area under Chandeleur, Mobile, and Viosca Knoll.

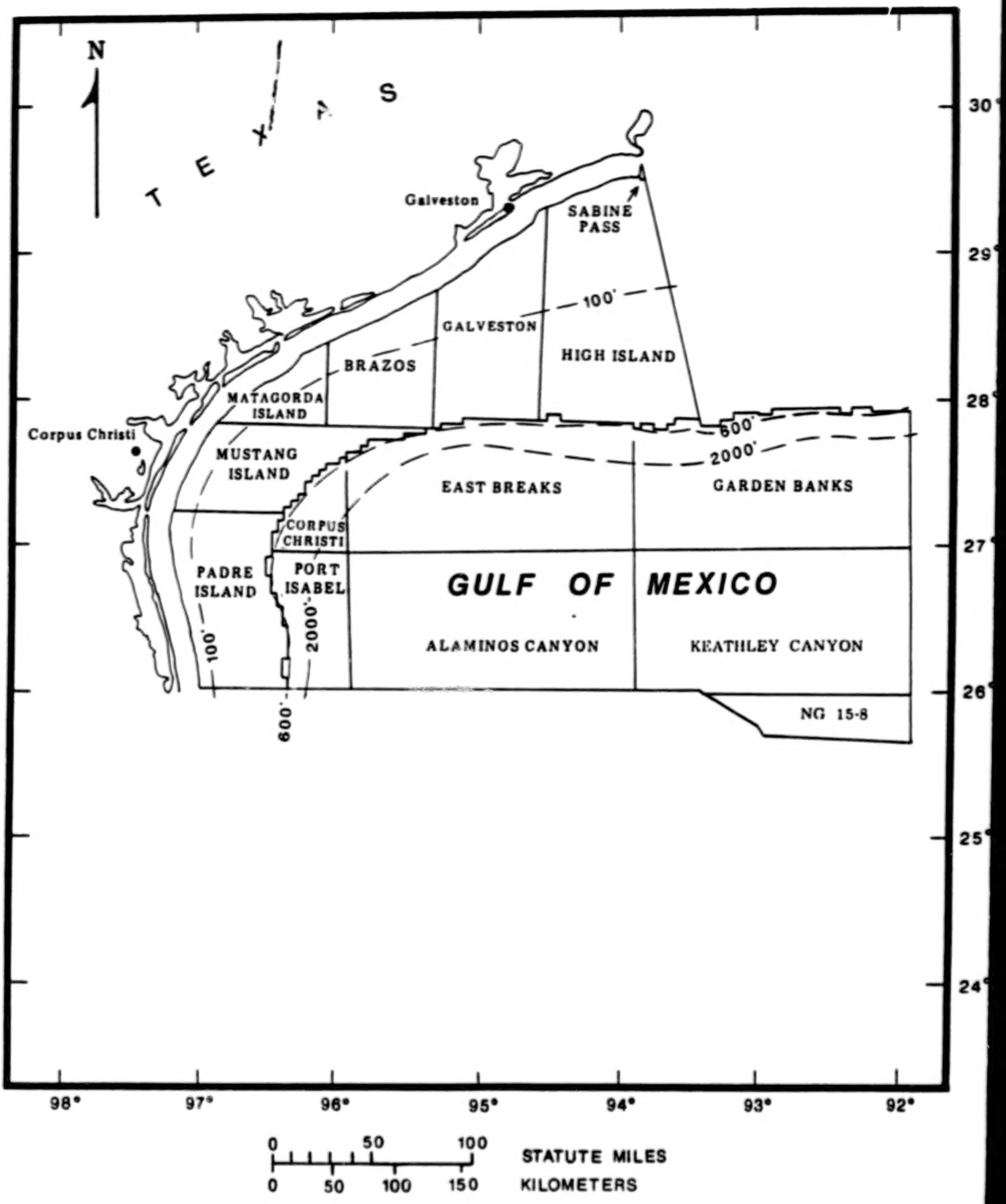


Figure 3.—Western Planning Area, Gulf of Mexico, Outer Continental Shelf. Dash lines indicate water depths in feet.

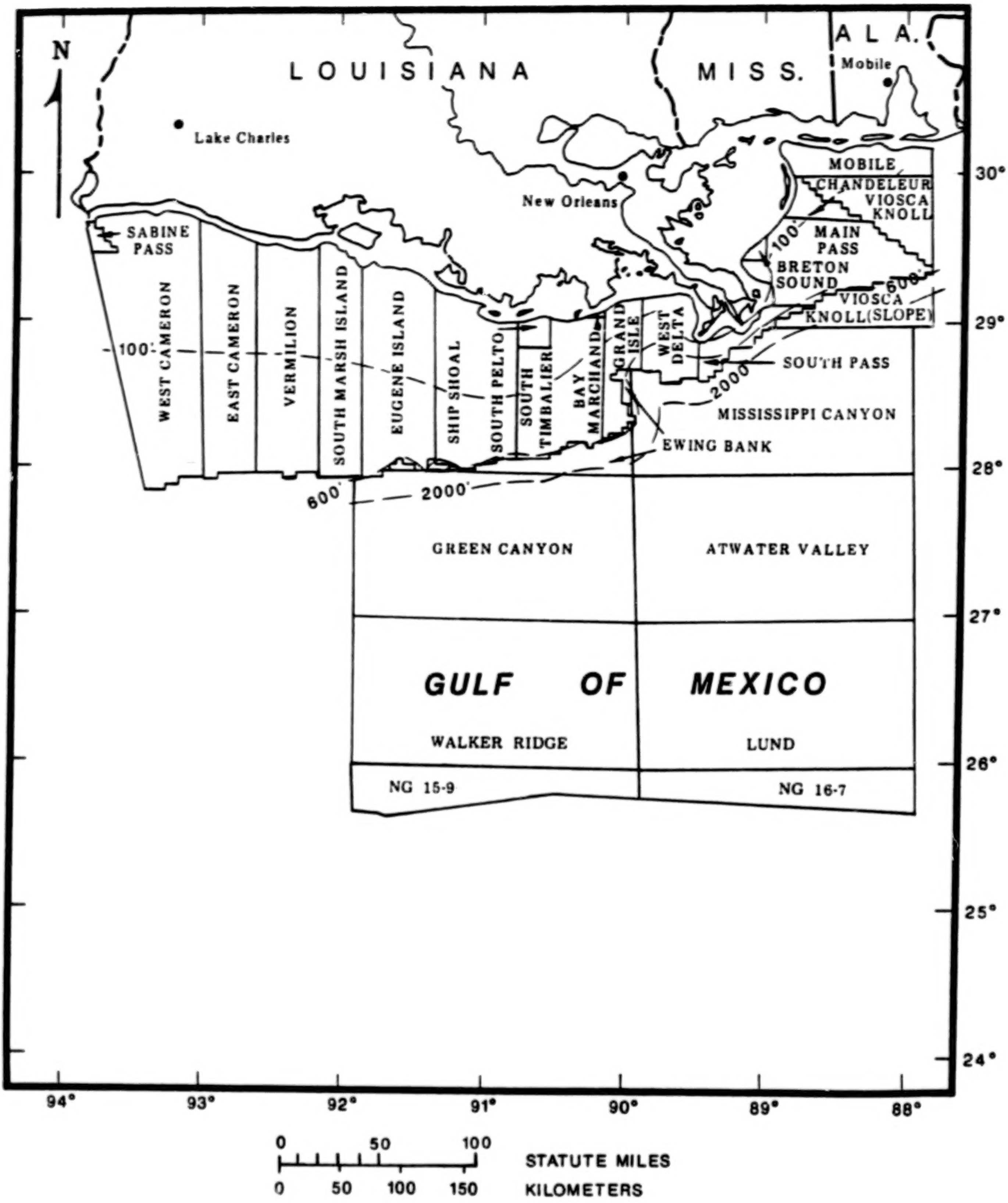


Figure 4.—Central Planning Area, Gulf of Mexico, Outer Continental Shelf. Dash lines indicate water depths in feet.

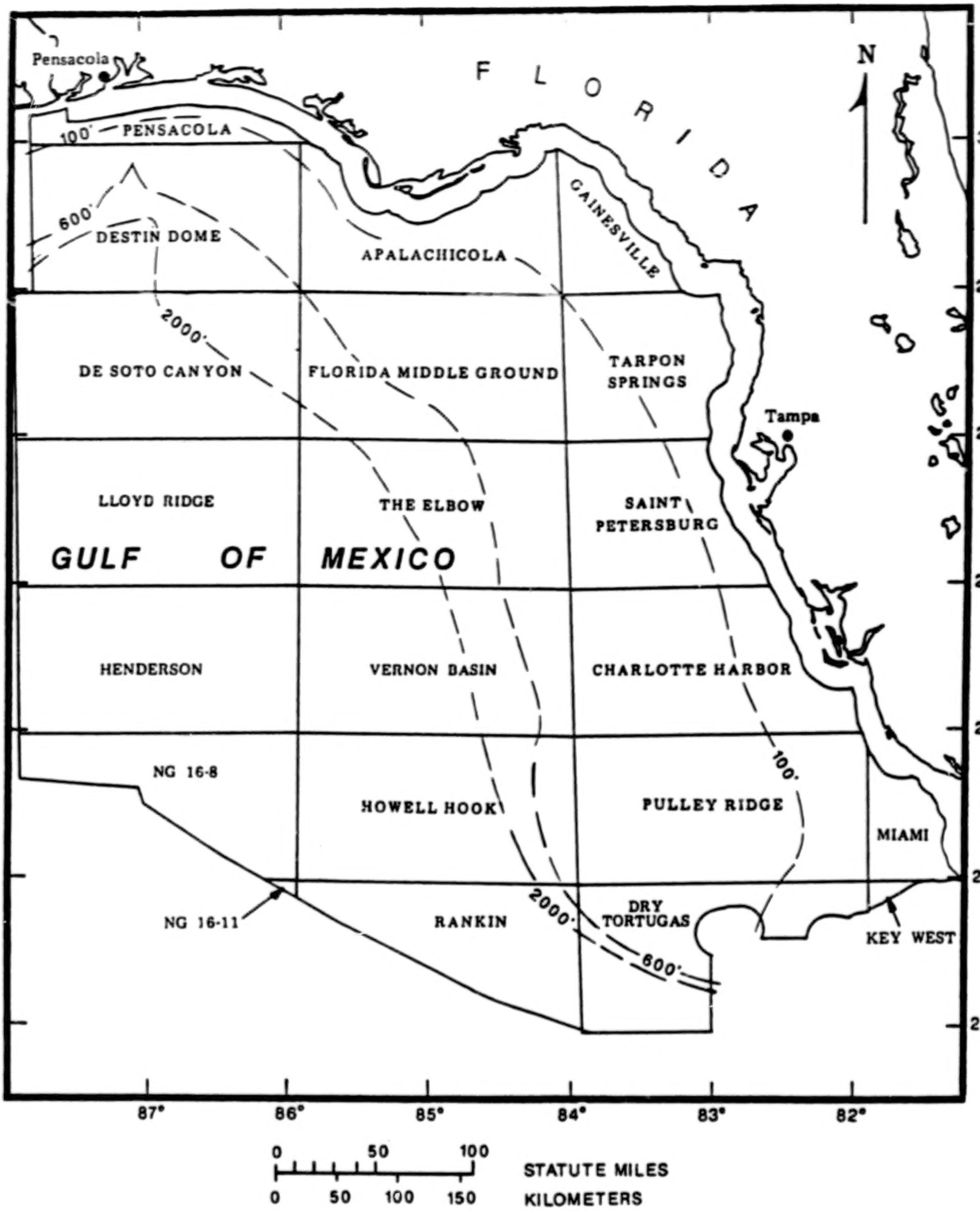


Figure 5.—Eastern Planning Area, Gulf of Mexico, Outer Continental Shelf. Dash lines indicate water depths in feet.

On December 31, 1989, there were 796 active fields in the federally regulated part of the Gulf of Mexico, as listed by the MMS Gulf of Mexico Regional Field Names Committee. Of these, 682 were considered sufficiently developed to warrant estimation of reserves for this study. The remaining 114 were not sufficiently developed to permit a reasonably accurate estimate of reserves. In addition to the 682 active, studied fields, 57 depleted fields (abandoned after production) are reported herein. This makes a total of 739 fields for which oil and gas reserves were estimated. The 57 depleted fields are not included in the 796 active fields, but are reported here to give a complete record of cumulative oil and gas production. In addition, there were 30 fields that expired in 1989 that had been classified as unproved. From the time these fields qualified under 30 CFR 250.11 until the leases were relinquished, there was not enough activity by the operator to classify these fields as proved. The modifications to the reserve inventory database required by the new definitions of reserve and resource terms now permit the tabulation of unproved expired fields. From 1980 through 1989, 105 unproved fields expired. Before 1980, records of unproved expired fields are incomplete.

Reserves data and various classifications of fields, leases, boreholes, and completions are presented as area totals in tables 1 and 2, and the table 3 series. (The table 3 series will be discussed in the Section "Reserves Reported by Geologic Age," beginning on page 18). Estimates of proved reserves for all proved active producing fields, as well as all proved active nonproducing fields, are presented as area totals in table 1. The 739 fields

Table 1.—Estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989.

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s) (figs. 3, 4, and 5)	Number of fields: Proved active prod	Proved active nonprod	Proved expired depleted	Unproved active	Unproved expired 1989	Original recoverable reserves: Oil	Gas	Cumulative production through 1989: Oil	Gas	Remaining recoverable reserves: Oil	Gas
Western Planning Area											
Brazos	17	3	4	2	0	8	2,091	5	1,210	3	881
Galveston	21	2	2	2	1	27	1,181	22	855	5	326
High Island and Sabine Pass	89	3	5	5	6	317	12,389	174	7,840	143	4,549
Matagorda Island	21	6	0	1	1	35	5,521	7	1,419	28	4,102
Mustang Island and Padre Island	15	4	3	3	0	11	1,739	2	632	9	1,107
Western Slope*	5	1	0	9	1	141	966	19	135	122	831
Western Planning Area Subtotal	*168*	*19*	*14*	*22*	*9*	*539*	*23,887*	*229*	*12,091*	*310*	*11,796*
Central Planning Area											
Chandeleur, Mobile, and Viosca Knoll	6	20	0	14	0	1	1,889	0	177	1	1,712
East Cameron	44	1	8	5	1	264	8,830	183	6,780	81	2,050
Eugene Island	50	4	7	4	2	1,340	15,395	1,017	11,582	323	3,813
Grand Isle	10	0	3	2	0	922	3,917	772	3,188	150	729
Main Pass and Breton Sound	35	7	1	6	0	871	4,230	609	2,902	262	1,328
South Pelto	6	0	1	0	0	132	707	94	458	38	249
South Marsh Island	33	5	4	2	1	782	12,048	563	9,064	219	2,984
South Pass	10	1	0	2	0	935	2,817	699	2,045	236	772
Ship Shoal	47	4	4	4	2	1,248	10,561	918	8,000	330	2,561
South Timbalier	29	4	1	5	2	1,302	6,950	1,059	4,731	243	2,219
Vermilion	60	3	5	4	2	474	14,781	329	11,287	145	3,494
West Cameron and Sabine Pass	80	2	8	5	4	185	16,488	115	12,253	70	4,235
West Delta	17	1	1	3	0	1,201	4,395	1,047	3,585	154	810
Central Slope†	12	3	0	33	7	678	2,203	209	776	469	1,427
Central Planning Area Subtotal	*439*	*55*	*43*	*89*	*21*	*10,335*	*105,211*	*7,614*	*76,828*	*2,721*	*28,383*
Eastern Planning Area Subtotal‡	*0*	*1*	*0*	*3*	*0*	-	-	-	-	-	-
GOM Total	*607*	*75*	*57*	*114*	*30*	*10,874*	*129,098*	*7,843*	*88,919*	*3,031*	*40,179*
		739									

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.

†Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Mississippi Canyon, Viosca Knoll (slope) and Walker Ridge

‡Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola, Pulley Ridge, and others.

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Table 2.—Status of oil and gas leases, boreholes, and completions by area, Gulf of Mexico Outer Continental Shelf, December 31, 1989

Area(s) (Figs. 3, 4, and 5)	Number of leases studied Proved* Active	Abandoned	Number of leases Unproved qualified	Exploratory	Expired	Number of boreholes Drilled	Abandoned	Number of active completions
Western Planning Area								
Brazos	37	6	1	86	113	361	193	138
Galveston	34	8	2	135	254	403	280	139
High Island and Sabine Pass	187	21	5	239	393	2,061	1,024	1,036
Matagorda Island	59	1	2	43	59	409	142	220
Mustang Island and Padre Island	34	3	4	219	268	353	206	132
Western Slope†	17	0	10	647	211	257	158	81
Western Planning Area Subtotal	***368***	***39***	***24***	***1,369***	***1,298***	***3,844***	***2,003***	***1,746***
Central Planning Area								
Chandeleur, Mobile, and Viosca Knoll	41	1	15	109	64	141	51	41
East Cameron	99	30	6	144	214	1,512	796	777
Eugene Island	175	36	4	108	197	3,366	1,580	1,928
Grand Isle	49	8	4	22	58	1,094	601	691
Main Pass and Breton Sound	113	11	6	75	179	1,731	659	1,302
Ship Shoal	140	17	5	112	192	2,605	1,226	1,574
South Marsh Island	96	15	3	69	117	1,951	837	1,148
South Pass	49	2	3	6	45	1,510	657	904
South Pelto	13	3	0	6	13	266	139	153
South Timbalier	108	8	9	100	181	2,052	821	1,433
Vermilion	156	30	4	110	229	2,041	1,020	1,075
West Cameron and Sabine Pass	216	40	5	170	335	2,346	1,222	1,193
West Delta	71	11	3	42	85	2,197	1,115	1,415
Central Slope‡	41	0	52	957	267	914	572	259
Central Planning Area Subtotal	***1,367***	***212***	***119***	***2,030***	***2,176***	***23,726***	***11,296***	***13,893***
Eastern Planning Area Subtotal§	***2***	***0***	***3***	***312***	***167***	***44***	***37***	***0***
GOM Total	***1,737***	***251***	***146***	***3,711***	***3,641***	***27,614***	***13,336***	***15,639***

*These numbers do not include active leases in studied, unproved fields.

†Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.

‡Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.

§Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola, Pulley Ridge, and others.

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studied (682 active fields and 57 depleted fields) constitute the current listing in the MMS Outer Continental Shelf Information System (OCSIS). The 114 unproved fields are not represented in the reserves data.

The status of Gulf of Mexico OCS Federal oil and gas leases issued as of December 31, 1989, are represented in table 2. The 5,594 active leases (1,737 proved active studied, 146 unproved qualified, and 3,711 exploratory) and 3,892 relinquished leases (251 proved abandoned studied and 3,641 expired) are classified into one of two main groups, proved and unproved. Further subgrouping and definitions of the groups follow:

Proved Active — Active leases within the designated 682 proved active fields presented in table 1.

Proved Abandoned — Leases relinquished after oil and gas production. The leases associated with the 57 depleted fields are represented here along with other produced, relinquished leases that were once part of currently active fields. Expired leases without oil or gas production are classified as *expired* even though they were once part of a studied field.

Unproved Qualified — Leases associated with the 114 fields insufficiently developed for study. The leases have qualified as producible under 30 CFR 250.11, but the operators have not established a commitment to produce. These fields may be classified as unproved possible or unproved probable.

Exploratory — Active leases not yet qualified as producible or associated with any field.

Expired — Leases relinquished by the operator without having produced any oil or gas, even though some were once qualified producible under 30 CFR 250.11.

Also shown in table 2 are the total number of boreholes drilled and the number of those boreholes that have been plugged and abandoned in accordance with 30 CFR Part 250, Subpart G, Abandonment of Wells.

Because of reporting procedures, an accurate assessment of annual drilling activity cannot be obtained by comparisons of table 2 borehole counts of successive years. There were 896 boreholes spudded during 1989, compared with 928 during 1988 and 800 during 1987. The last column of table 2 presents the total number of active completions per area. Active completions are defined as those with perforations open to the formation and not isolated by permanent plugs; service wells (injection, disposal, or water source) are included. The presence or absence of production or injection is not considered. The number of boreholes and the number of active completions as of December 31, 1989, are based on reports received by MMS at the time the count was made in January 1990. These numbers may change when all data for 1989 have been received and processed.

Reserves Reported by Geologic Age

The reserves and production data of the 739 proved fields have been classified by geologic age (see table 4) of the reservoirs and are presented in tables 3 and 3a through 3f. Age determinations were made by paleontological examinations of borehole cuttings where feasible. In areas with limited paleontological information, geologic ages were extrapolated from adjacent blocks with biostratigraphic control.

The generalized locations of the major trends of the three series (Pleistocene, Pliocene, and Miocene) are shown in figure 6. The Pleistocene-Pliocene boundary is considered to be younger than the *Buliminella* 1 biostratigraphic marker and older than the *Valvulineria* "H" biostratigraphic marker. The Pliocene-Miocene boundary is considered to be younger than the *Robulus* "E" biostratigraphic marker and older than the *Textularia* 6 biostratigraphic marker. Overlapping of adjacent trends occurs to varying degrees but has not been presented. Tables 3a through 3f present reserves and production data by geologic age for each area. In table 3 reserves and production data for the Oligocene series and Cretaceous and Jurassic Systems are combined and presented as *Other.*

In the Western Planning Area, reserves are predominantly gas. Forty-seven percent of gas production has come from the Pleistocene trend. Proved remaining reserves of gas in the Western Planning Area are concentrated in the lower Miocene of the Matagorda Island Area (30%) and

Table 3.—Estimated oil and gas reserves for 739 proved fields by geologic age, Gulf of Mexico, Outer Continental Shelf, December 31, 1989.

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Geologic Age	Original recoverable reserves		Cumulative production through 1989		Remaining recoverable reserves	
	Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area						
Pleistocene	369	9,415	173	5,639	196	3,776
Pliocene	48	224	0	75	48	149
Upper Miocene	8	697	2	438	6	259
Middle Miocene	63	7,378	38	4,091	25	3,287
Lower Miocene	51	6,171	16	1,848	35	4,323
Other*	0	2	0	0	0	2
Western Planning Area Subtotal	***539***	***23,887***	***229***	***12,091***	***310***	***11,796***
Central Planning Area						
Pleistocene	3,719	42,505	2,407	30,363	1,312	12,142
Pliocene	3,005	19,071	2,330	13,588	675	5,483
Upper Miocene	2,991	22,812	2,426	17,415	565	5,397
Middle Miocene	557	16,579	410	13,143	147	3,436
Lower Miocene	51	2,613	38	1,952	13	661
Other*	12	1,631	3	367	9	1,264
Central Planning Area Subtotal	***10,335***	***105,211***	***7,614***	***76,828***	***2,721***	***28,383***
Eastern Planning Area	-	-	***0***	***0***	-	-
GOM Total	***10,874***	***129,098***	***7,843***	***88,919***	***3,031***	***40,179***

*Other includes Oligocene, Cretaceous, and Jurassic.

Table 3a. — Pleistocene estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	Number of reservoirs	Original recoverable reserves		Cumulative production through 1989		Remaining recoverable reserves	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
Galveston	17	0	87	0	51	0	36
High Island and Sabine Pass	992	275	8,423	154	5,453	121	2,970
Western Slope*	85	94	905	19	135	75	770
Western Planning Area Subtotal	***1,094***	***369***	***9,415***	***173***	***5,639***	***196***	***3,776***
Central Planning Area							
East Cameron	493	186	4,261	129	3,148	57	1,113
Eugene Island	1,547	842	10,513	624	8,160	218	2,353
Grand Isle	99	7	1,269	6	1,075	1	194
Main Pass and Breton Sound	147	75	142	47	101	28	41
South Pelto	61	17	11	12	7	5	4
South Marsh Island	577	474	2,741	343	1,757	131	984
South Pass	203	174	438	86	280	88	158
Ship Shoal	1,214	756	6,339	575	4,931	181	1,408
South Timbalier	746	273	3,899	178	2,707	95	1,192
Vermilion	691	225	3,877	155	2,611	70	1,266
West Cameron and Sabine Pass	645	25	7,099	15	4,963	10	2,136
West Delta	67	79	399	73	294	6	105
Central Slope†	270	586	1,517	164	329	422	1,188
Central Planning Area Subtotal	***6,760***	***3,719***	***42,505***	***2,407***	***30,363***	***1,312***	***12,142***
GOM Total	***7,854***	***4,088***	***51,920***	***2,580***	***36,002***	***1,508***	***15,918***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.

†Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Mississippi Canyon, Viosca Knoll (slope) and Walker Ridge.

Table 3b. — Pliocene estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	Number of reservoirs	Original recoverable reserves		Cumulative production through 1989		Remaining recoverable reserves	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
High Island and Sabine Pass	20	1	165	0	75	1	90
Western Slope*	2	47	59	0	0	47	59
Western Planning Area Subtotal	***22***	***48***	***224***	***0***	***75***	***48***	***149***
Central Planning Area							
Chandeleur, Mobile and Viosca Knoll	11	1	211	0	4	1	207
East Cameron	64	8	413	5	261	3	152
Eugene Island	643	305	2,004	234	1,378	71	626
Grand Isle	284	312	823	262	670	50	153
Main Pass and Breton Sound	272	219	1,000	134	686	85	314
South Pelto	63	32	37	24	28	8	9
South Marsh Island	616	122	4,209	99	3,491	23	718
South Pass	713	689	2,254	548	1,657	141	597
Ship Shoal	626	325	2,157	246	1,508	79	649
South Timbalier	489	270	1,273	216	773	54	500
Vermilion	319	103	2,062	72	1,358	31	704
West Cameron and Sabine Pass	146	5	939	2	597	3	342
West Delta	492	532	1,011	443	730	89	281
Central Slope†	80	82	678	45	447	37	231
Central Planning Area Subtotal	***4,818***	***3,005***	***19,071***	***2,330***	***13,588***	***675***	***5,483***
GOM Total	***4,840***	***3,053***	***19,295***	***2,330***	***13,663***	***723***	***5,632***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.

†Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Mississippi Canyon, Visoca Knoll (slope), and Walker Ridge.

Table 3c.—Upper Miocene estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	**Number of reservoirs**	**Original recoverable reserves**		**Cumulative production through 1989**		**Remaining recoverable reserves**	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
Brazos	2	0	5	0	0	0	5
Galveston	42	1	150	0	53	1	97
High Island and Sabine Pass	40	3	433	2	318	1	115
Matagorda Island	9	0	44	0	34	0	10
Mustang island and Padre Island	8	4	65	0	33	4	32
Western Planning Area Subtotal	***101***	***8***	***697***	***2***	***438***	***6***	***259***
Central Planning Area							
Chandeleur, Mobile and Viosca Knoll	21	0	369	0	173	0	196
East Cameron	57	3	862	1	677	2	185
Eugene Island	497	177	2,483	147	1,796	30	687
Grand Isle	452	603	1,825	504	1,443	99	382
Main Pass and Breton Sound	489	390	2,231	258	1,462	132	769
South Pelto	288	83	659	58	423	25	236
South Marsh Island	214	84	1,867	65	1,322	19	545
South Pass	25	72	125	65	108	7	17
Ship Shoal	350	167	2,065	97	1,561	70	504
South Timbalier	588	759	1,778	665	1,251	94	527
Vermilion	239	45	3,976	25	3,254	20	722
West Cameron and Sabine Pass	149	14	1,584	10	1,384	4	200
West Delta	525	590	2,985	531	2,561	59	424
Central Slope*	6	4	3	0	0	4	3
Central Planning Area Subtotal	***3,900***	***2,991***	***22,812***	***2,426***	***17,415***	***565***	***5,397***
GOM Total	***4,001***	***2,999***	***23,509***	***2,428***	***17,853***	***571***	***5,656***

*Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Mississippi Canyon, Visoca Knoll (slope), and Walker Ridge.

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Table 3d. -- Middle Miocene estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	**Number of reservoirs**	**Original recoverable reserves**		**Cumulative production through 1989**		**Remaining recoverable reserves**	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
Brazos	272	8	2,086	5	1,210	3	876
Galveston	158	26	943	22	750	4	193
High Island and Sabine Pass	242	20	2,207	9	1,389	11	818
Matagorda Island	74	3	839	0	252	3	587
Mustang Island and Padre Island	184	6	1,303	2	490	4	813
Western Planning Area Subtotal	***930***	***63***	***7,378***	***38***	***4,091***	***25***	***3,287***
Central Planning Area							
Chandeleur, Mobile and Viosca Knoll	9	0	136	0	0	0	136
East Cameron	158	58	2,976	41	2,457	17	519
Eugene Island	60	16	395	12	248	4	147
Main Pass and Breton Sound	63	184	853	170	653	14	200
South Marsh Island	83	102	3,231	56	2,494	46	737
Vermilion	175	101	4,866	77	4,064	24	802
West Cameron and Sabine Pass	395	96	4,122	54	3,227	42	895
Central Planning Area Subtotal	***943***	***557***	***16,579***	***410***	***13,143***	***147***	***3,436***
GOM Total	***1,873***	***620***	***23,957***	***448***	***17,234***	***172***	***6,723***

Table 3e. — Lower Miocene estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	Number of reservoirs	Original recoverable reserves		Cumulative production through 1989		Remaining recoverable reserves	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
Galveston	1	0	1	0	1	0	0
High Island and Sabine Pass	82	18	1,161	9	605	9	556
Matagorda Island	239	32	4,638	7	1,133	25	3,505
Mustang Island and Padre Island	58	1	371	0	109	1	262
Western Planning Area Subtotal	***380***	***51***	***6,171***	***16***	***1,848***	***35***	***4,323***
Central Planning Area							
East Cameron	34	9	312	7	231	2	81
West Cameron and Sabine Pass	266	42	2,301	31	1,721	11	580
Central Planning Area Subtotal	***300***	***51***	***2,613***	***38***	***1,952***	***13***	***661***
GOM Total	***680***	***102***	***8,784***	***54***	***3,800***	***48***	***4,984***

Table 3f. — Oligocene, Cretaceous, and Jurassic estimated oil and gas reserves for 739 proved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1989

(Proved reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	**Number of reservoirs**	**Original recoverable reserves**		**Cumulative production through 1989**		**Remaining recoverable reserves**	
		Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area							
Western Slope*	1	0	2	0	0	0	2
Western Planning Area Subtotal	***1***	***0***	***2***	***0***	***0***	***0***	***2***
Central Planning Area							
Chandeleur, Mobile, and Viosca Knoll	9	0	1,173	0	0	0	1,173
East Cameron	1	0	6	0	6	0	0
Main Pass and Breton Sound	1	3	4	0	0	3	4
West Cameron and Sabine Pass	46	3	443	3	361	0	82
Central Slope†	1	6	5	0	0	6	5
Central Planning Area Subtotal	***58***	***12***	***1,631***	***3***	***367***	***9***	***1,264***
GOM Total	***59***	***12***	***1,633***	***3***	***367***	***9***	***1,266***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.

†Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Mississippi Canyon, Viosca Knoll (slope) and Walker Ridge.

Table 4.—Major geochronological and chronostratigraphic units.

(Modified from U.S. Geological Survey Geologic Names Committee, 1980 edition)

Subdivisions in use by the Minerals Management Service					Age estimates million years
Phanerozoic Eon or Eonothem	Cenozoic Era or Erathem	Quaternary Period or System		Holocene Epoch or Series	0.010
				Pleistocene Epoch or Series	2.8
		Tertiary Period or System	Neogene Subperiod or Subsystem	Pliocene Epoch or Series	5.4
				Miocene Epoch or Series	24
			Paleogene Subperiod or Subsystem	Oligocene Epoch or Series	38
				Eocene Epoch or Series	55
				Paleocene Epoch or Series	63
	Mesozoic Era or Erathem	Cretaceous Period or System		Late Cretaceous Epoch or Upper Cretaceous Series	96
				Early Cretaceous Epoch or Lower Cretaceous Series	138
		Jurassic Period or System			205
		Triassic Period or System			~240

the Pleistocene of the High Island and Sabine Pass Area (25%). Reserves in the Mustang Island and Padre Island Areas appear limited due to poor sand conditions.

In the Central Planning Area, reserves, both proved original and proved remaining, are primarily of Pleistocene age. Within the Pleistocene, the Eugene Island Area has been the major contributor of oil (26%) and gas (27%) production. The Pleistocene of the Eugene Island Area is still the primary area for proved remaining gas reserves (8%) in the Central

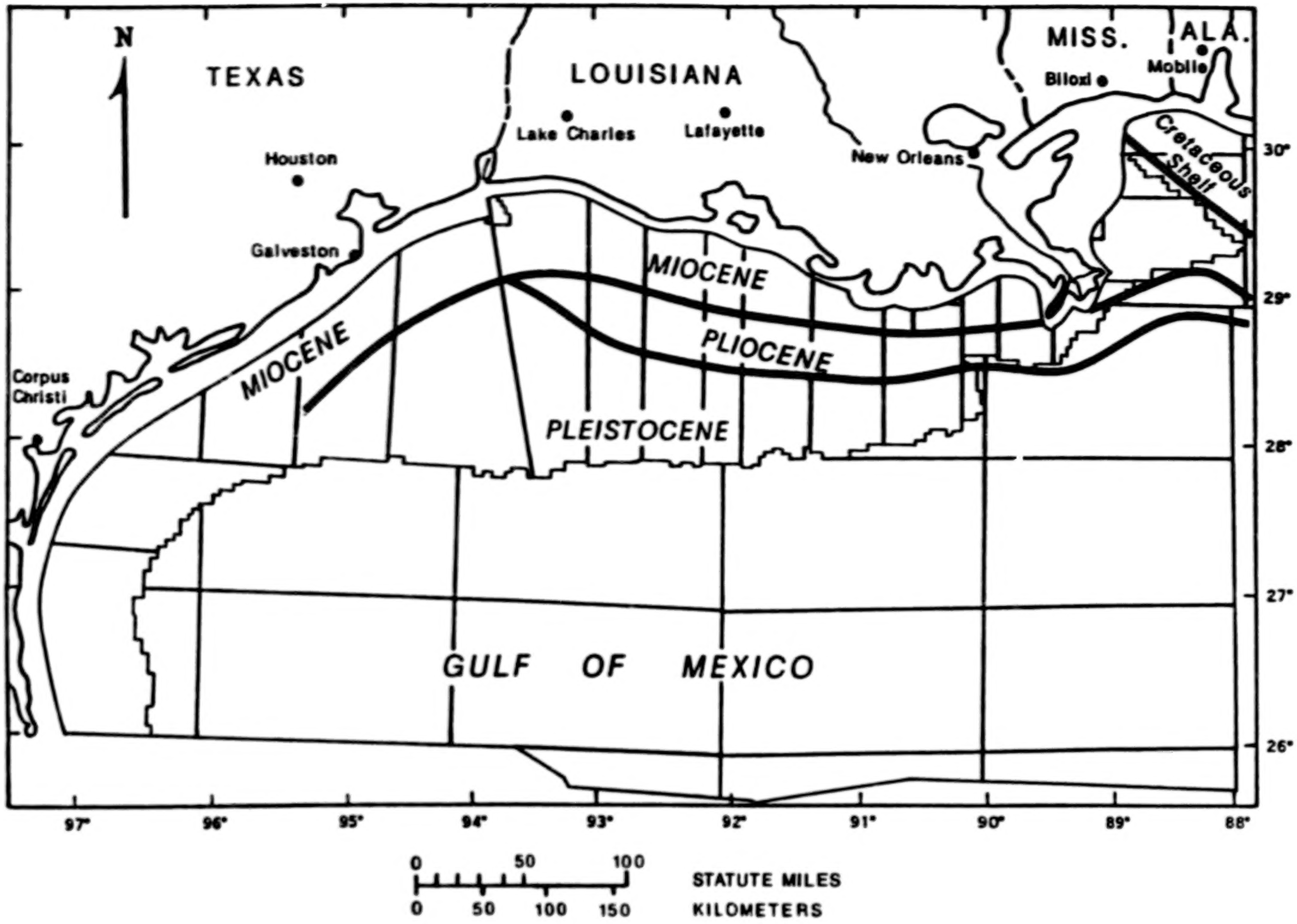


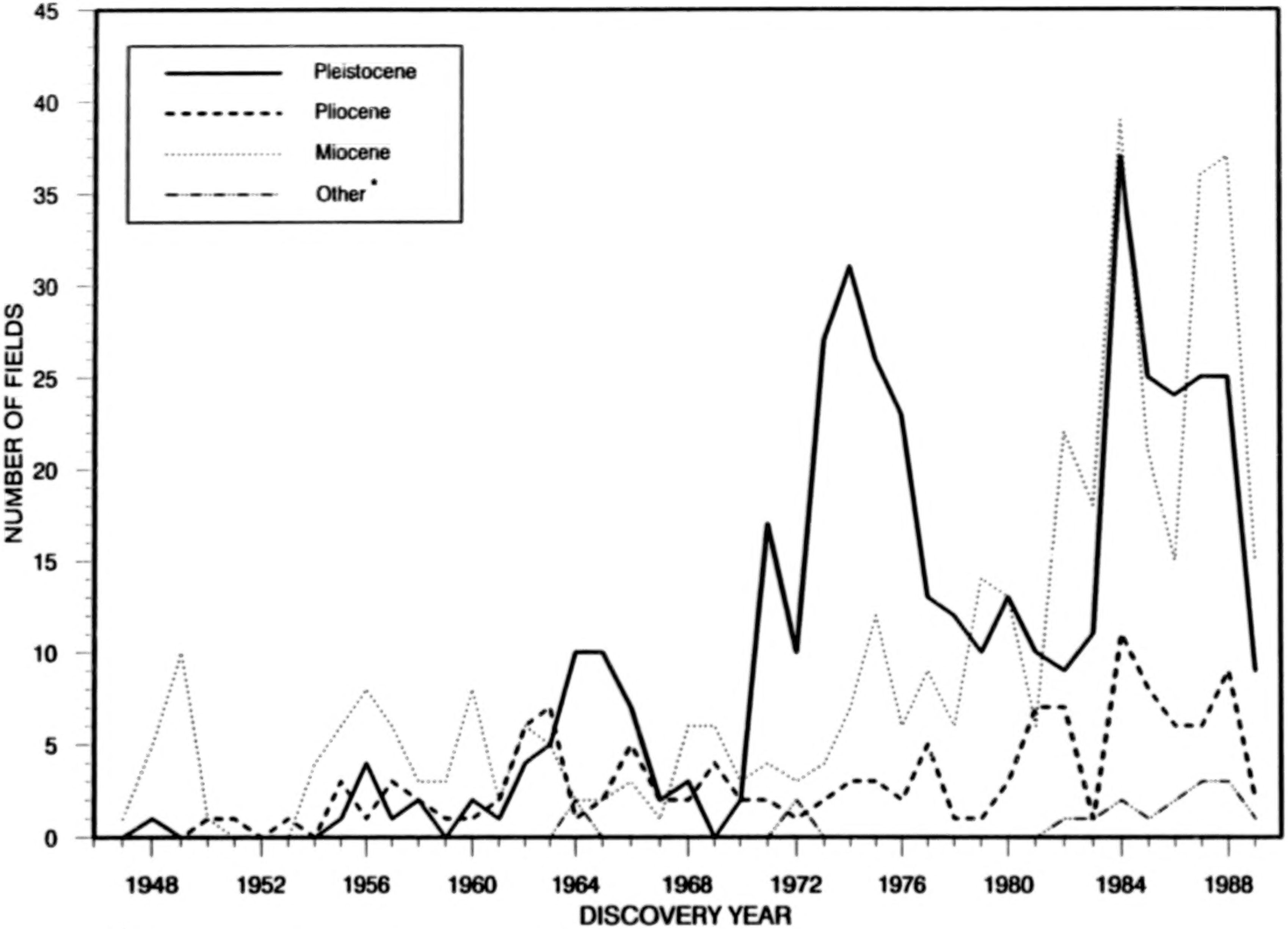
Figure 6.—Major production trends by geologic age, Western and Central Planning Areas, Gulf of Mexico.

Planning Area. The Pleistocene of the central slope is now considered to contain, by area, the largest amount of proved remaining oil reserves (16%) in the Central Planning Area.

Of the three major trends, Pliocene reserves are less significant to the Gulf of Mexico reserve base than those of Pleistocene and Miocene Age because of more restricted sand deposition and thickness of section. The greatest thickness of Pliocene deposition, located in the Eugene Island, South Marsh Island, South Pass, and Ship Shoal Areas, coincides with the considerable amounts of proved remaining oil and gas reserves within this age.

Reserves age-dated in Oligocene, Cretaceous, and Jurassic are the least contributive in the GOM because of escalated drilling costs to reach depth of section and the uncertainties of geological conditions at this time. In the Mobile area, recent discoveries of Jurassic Age seem quite promising, but given the rudimentary status of infrastructure and logistics, operation and exploitation of these reserves are still being studied.

In figure 7, fields are age-dated by means of paleontological examination. These fields are then plotted against the discovery year as defined by 30 CFR 250.11. Through the 1960's, most fields discovered in the Gulf of Mexico were Miocene in age, the prolific trend reflecting the nearshore operating environment. After numerous substantial discoveries on large geologic structures, the need to continue locating fields of significant magnitude was pursued by exploring in deeper water. This pursuit is indicated by the fact that the majority of field discoveries in the 1970's and 1980's were of Pleistocene Age. Technological advances in geophysical data processing and deeper drilling depths in the mature Miocene province account for the resurgence of Miocene Age discoveries in the 1980's. Area-wide lease offerings beginning in May 1983 have allowed for more participation and activity from companies in developing their own exploration techniques, practices, and assessments leading toward an increase in field discoveries.



* Other includes Oligocene, Cretaceous, and Jurassic

Figure 7.—Annual field discoveries by geologic age.

Studies Conducted

Geologic maps and reserve estimates have been completed for 522 of the 739 fields, resulting in studies of approximately 17,345 individual reservoirs. Preliminary geologic studies were conducted for another 217 fields containing an additional 1,932 reservoirs. A volumetric estimate was made for each reservoir, and at least one other estimation method (for example, decline curve analysis) was used for many of the reservoirs. The subsequent performances of the reservoirs are periodically compared with the original projections, and revisions to these projections are made as needed.

Each abandoned field that had production has been assigned a value for original recoverable hydrocarbons equal to the amount actually produced.

Field-Size Distribution

The distribution of original recoverable reserves based on field size is shown in figures 8, 9, and 10. Figure 8 shows the field-size distribution of the original recoverable reserves for the 140 fields primarily producing oil, and figure 9 shows the field-size distribution of original recoverable reserves for the 599 fields primarily producing gas. Figure 10 shows the field-size distribution of the total original recoverable hydrocarbon reserves for the 739 fields included in this report. For convenience of comparison, gas reserves are expressed in terms of barrels of oil equivalent (BOE) and added to the liquid reserves expressed in barrels. The conversion factor of 5,620 standard cubic feet of gas equals one BOE is based on the average heating values of domestic hydrocarbons. To standardize its reporting, MMS has changed this parameter from previous reports. A geometric progression was selected for the horizontal scales in consideration of the lognormal type of distribution.

The oil field median size (exceeded by 50 percent of the fields) is 63 million BOE (MMBOE) and the mean (average) is 100 MMBOE. The gas/oil ratio (recoverable gas divided by recoverable oil) of the 140 oil fields is 3,130 cubic feet per barrel. The largest three ranges, representing 25 oil fields, contained 56 percent of the total original recoverable reserves contained in the 140 fields.

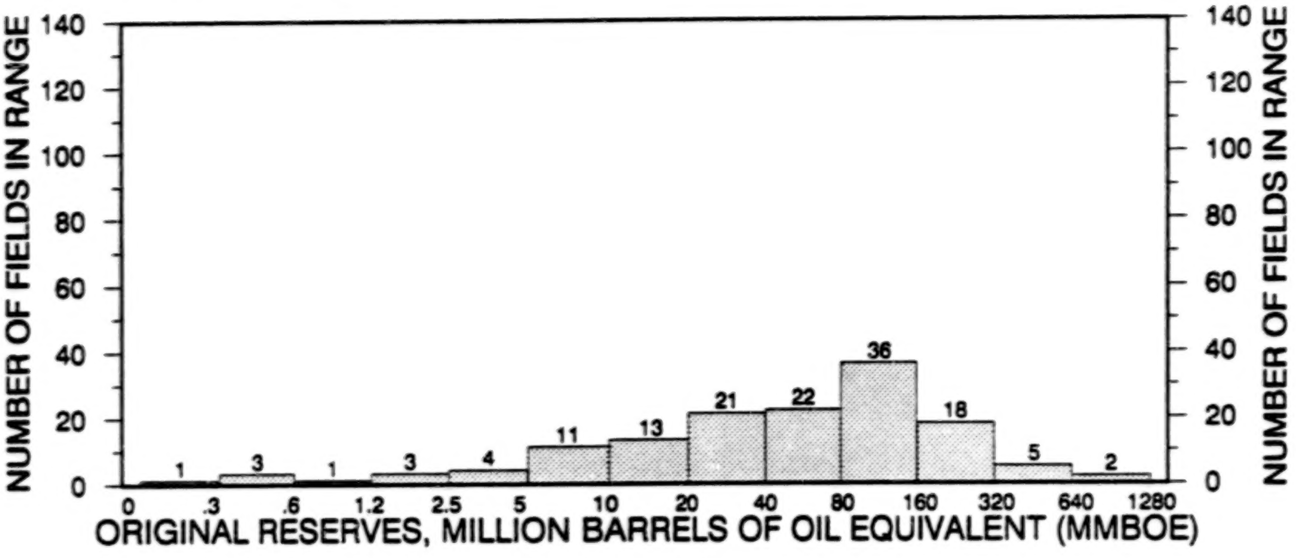


Figure 8.—Field-size distribution, 140 oil fields.

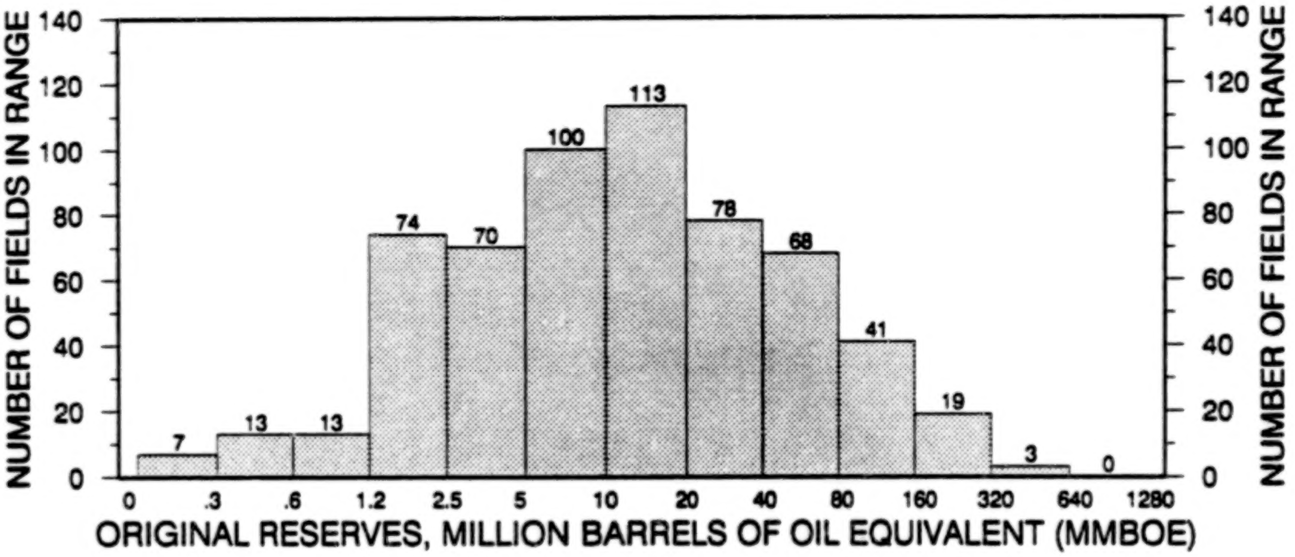


Figure 9.—Field-size distribution, 599 gas fields.

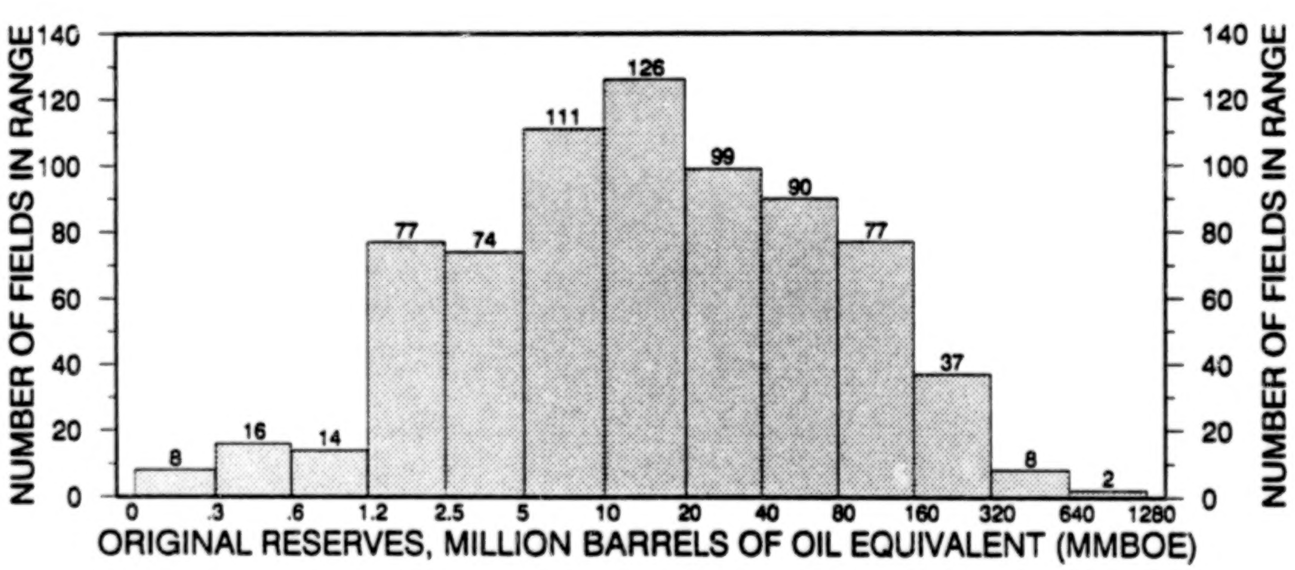


Figure 10.—Field-size distribution, 739 proved fields.

Among the 599 gas fields (fig. 9), the median is 10 MMBOE, and the mean is 33 MMBOE. The total liquid yield of the 599 gas fields is 18.3 barrels per million cubic feet. The largest three ranges, representing 22 gas fields, contained 31 percent of the total recoverable gas reserves.

Figure 10 shows the field-size distribution of the original recoverable hydrocarbon reserves of all 739 fields. The median field reserve is 15 MMBOE, and the mean is 46 MMBOE. The largest three ranges, representing 47 fields, contained 41 percent of the total recoverable hydrocarbon reserves.

Figure 11 shows the cumulative percent distribution of originally recoverable reserves in BOE by field rank for the 739 proved fields in the Gulf of Mexico OCS. As is typical of most hydrocarbon-producing basins, the distribution of field sizes in the Gulf of Mexico OCS is generally lognormal. Thus, there are a few very large fields and many small fields. Twenty-five percent of originally recoverable reserves are contained in the 20 largest fields. Fifty percent of originally recoverable reserves are contained in the 67 largest fields. Ninety percent of originally recoverable reserves are contained in the 300 largest fields.

Figure 12 shows the distribution of the number of fields and originally recoverable reserves by water depth. The originally recoverable reserves, reported in MMBOE, are associated with only the 739 proved fields. The 114 unproved active fields are presented to show current interest and

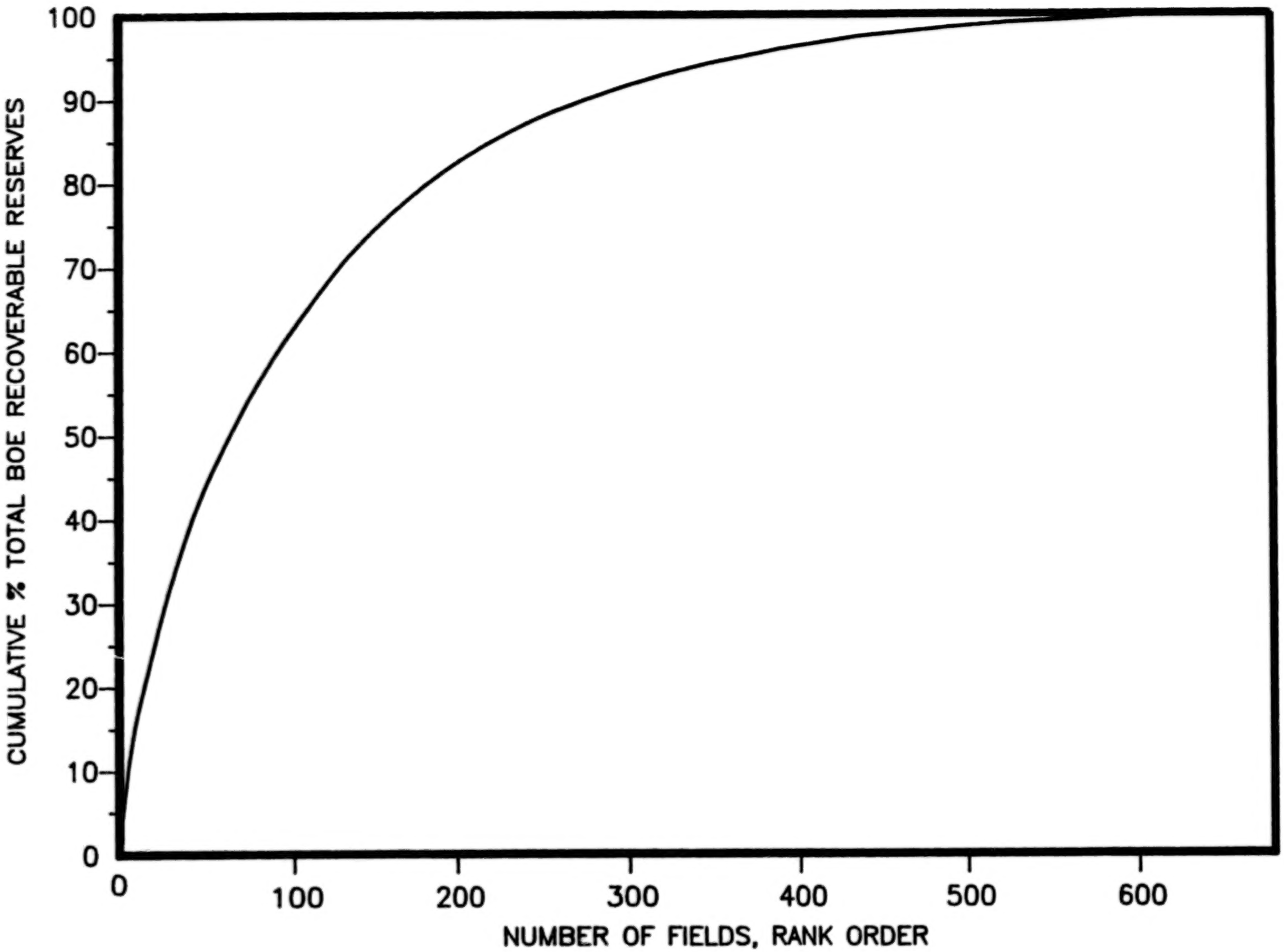


Figure 11.—Number of fields, rank order vs. percentage of total BOE recoverable reserves for 739 proved fields.

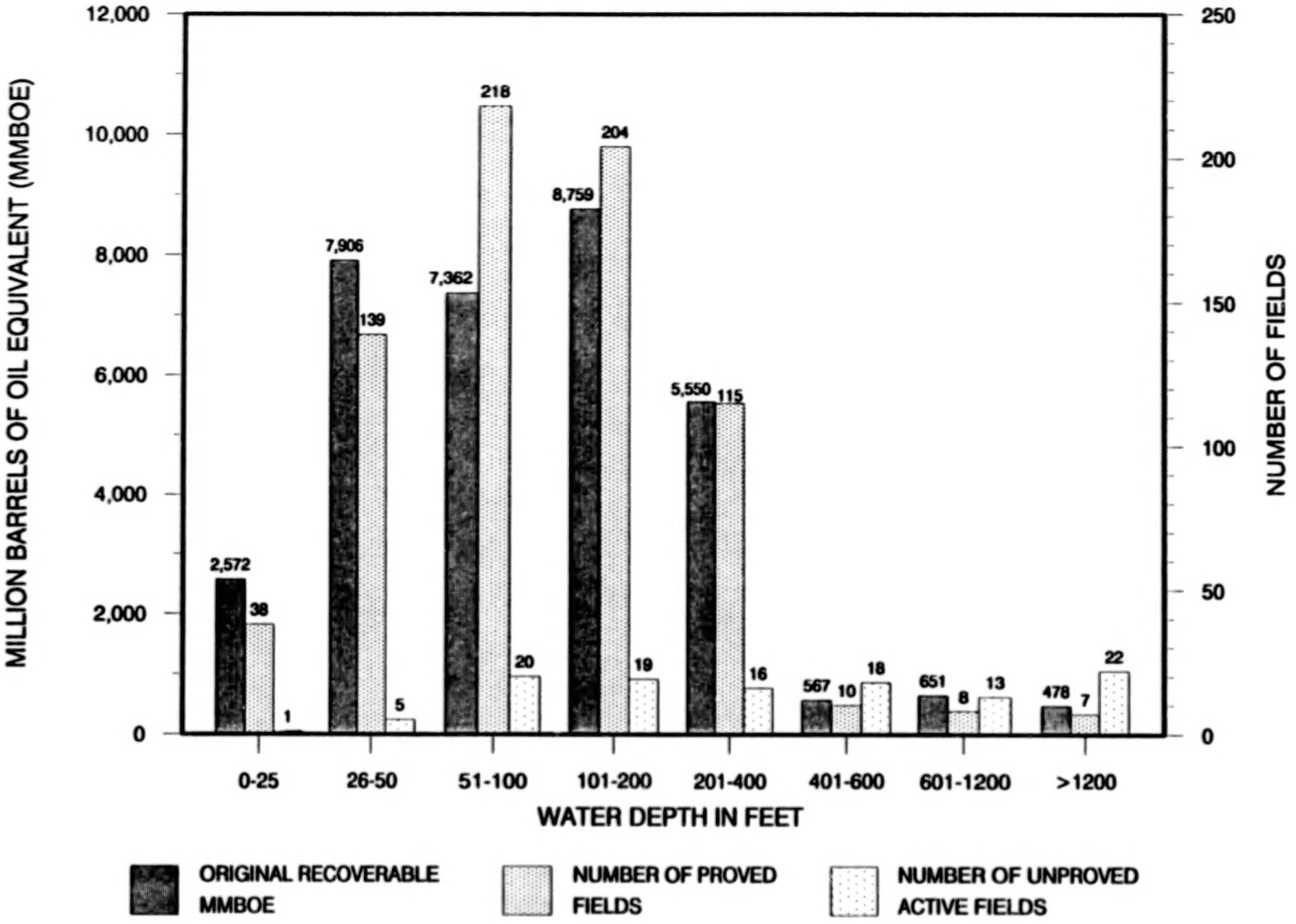


Figure 12.—Field and reserves distribution by water depth.

development. Proved reserves in the Gulf of Mexico show a large number of reserves located in less than 200 ft of water (79%). Proved reserves on the Continental Shelf (less than 600 ft of water) account for 97 percent of current proved reserves. Development on the slope (greater than 600 ft of water) reflects a sizable amount of reserves associated with a few fields. This is to be expected given the economics associated with deep-water drilling and development.

Reservoir-Size Distribution

The distribution of the various sizes of the proved reservoirs is shown in figures 13, 14, and 15. The size ranges, which are based on original hydrocarbons in place, are presented on the logarithmic, horizontal scale. The number of reservoirs in each size grouping, shown as percentages of the total, is presented on the linear, vertical scale. Combination reservoirs (saturated oil rims with associated gas caps) are shown in figure 13. For the combination reservoirs, gas is converted to BOE and added to the oil. Figure 14 shows the reservoir-size distribution, based on original oil in place, of proved undersaturated oil reservoirs, and figure 15 shows the reservoir-size distribution, based on original gas in place, of the nonassociated gas reservoirs. Reservoirs for which complete data are not available are excluded.

For the 862 proved combination reservoirs (fig. 13), the median is 2.5 MMBOE and the mean is 6.5 MMBOE. The average gas/oil ratio for the oil portion of the reservoirs is 1.5 thousand cubic feet (Mcf) per barrel, and the average yield for the gas cap is 26.7 bbl of condensate per million cubic feet (MMcf) of gas. Figure 14 shows the reservoir-size distribution, based on original oil in place, of 5,235 proved undersaturated oil reservoirs. The median is 0.8 million barrels of oil (MMbbl), the mean is 2.3 MMbbl, and the average gas/oil ratio is 1.4 Mcf per barrel. Figure 15 shows the

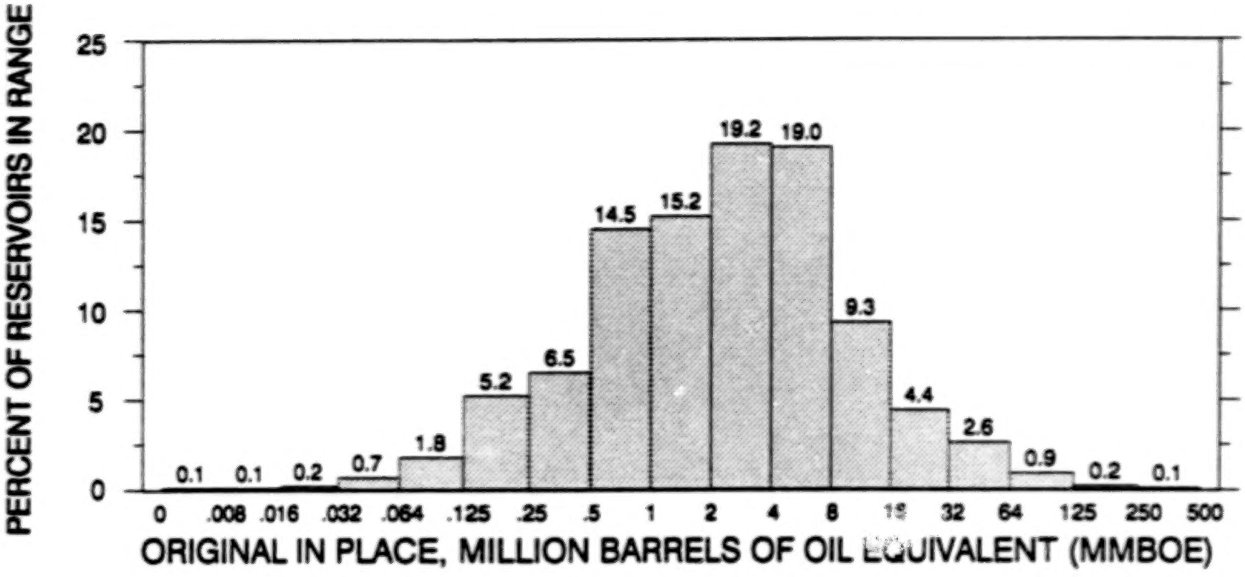


Figure 13.—Reservoir-size distribution, 862 combination reservoirs.

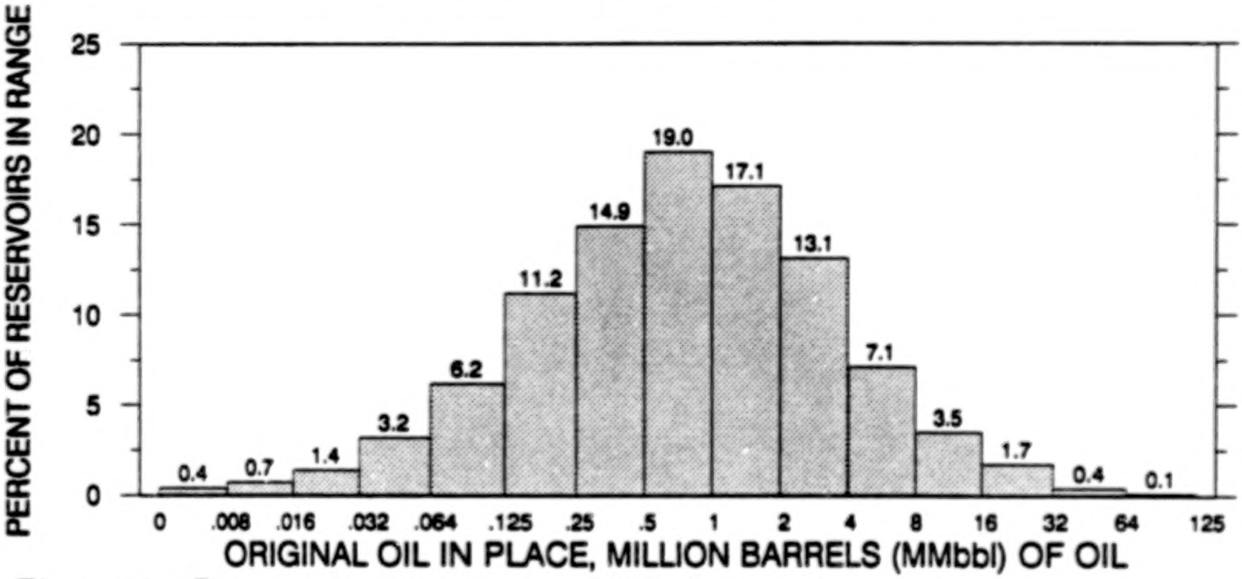


Figure 14.—Reservoir-size distribution, 5,235 oil reservoirs.

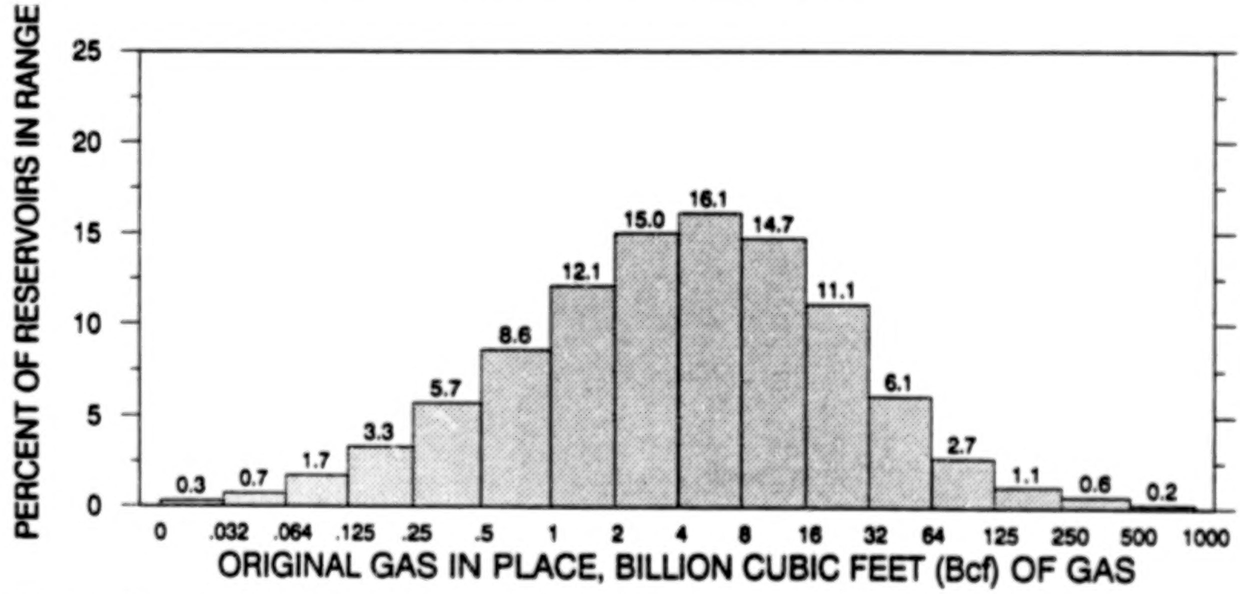


Figure 15.—Reservoir-size distribution, 7,344 gas reservoirs.

reservoir distribution of 7,344 nonassociated gas reservoirs. The median is 4.5 billion cubic feet (Bcf) of gas, the mean is 15.7 Bcf, and the average yield is 10.9 bbl of condensate per MMcf.

The average daily production during 1989 was 649,000 bbl of crude oil, 115,000 bbl of gas condensate, 1.20 Bcf of casinghead gas, and 11.47 Bcf of gas-well gas. The average gas/oil ratio (GOR) of oil wells was 1.84 Mcf per barrel, and the average condensate yield from gas wells was 10.01 bbl per MMcf.

Figures 16 and 17 show average monthly production-rate frequency distribution by completion as reported for 1989. The average monthly production was 19.7 MMbbl of crude oil and 349 Bcf of gas-well gas. Various production-rate ranges are shown on the logarithmic, horizontal scale, and the number of completions producing in that range is shown on the linear, vertical scale. To minimize the effect of test production, only those completions reported as having more than 2 days of production during the month were included. Other limiting factors include eliminating oil completions with a GOR greater than 50 Mcf/bbl or less than 1 bbl of production per day. Gas completions with a GOR less than 5 Mcf/bbl and less than 1 Mcf of production per day were also eliminated. Gas completions with no condensate production were not eliminated. Data was evaluated for each month, then averaged, instead of using the month of April as in past publications of *Estimated Oil and Gas Reserves on the Gulf of Mexico OCS*. For each grouping of production rates, two numbers are presented. The larger value represents the number of producing

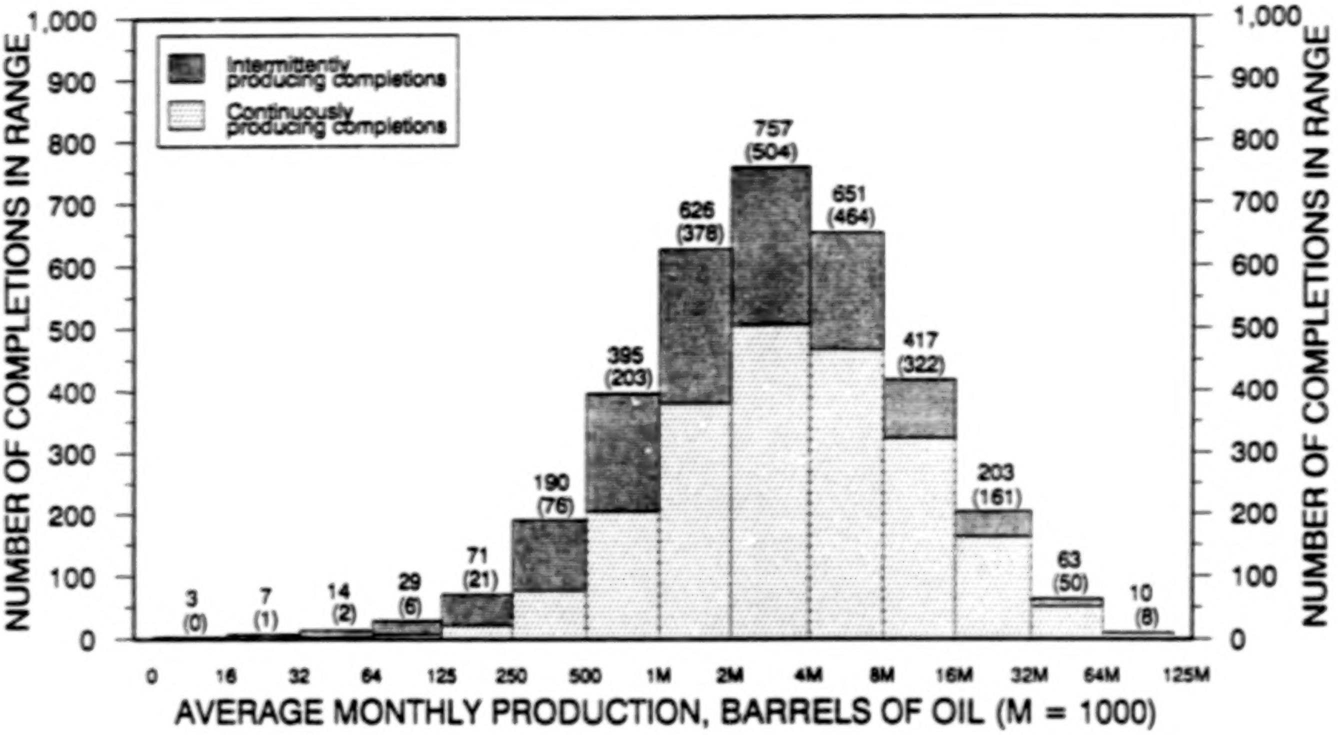


Figure 16.—Average monthly production distribution,
3,436 oil completions,
(2,196) continuously producing completions.

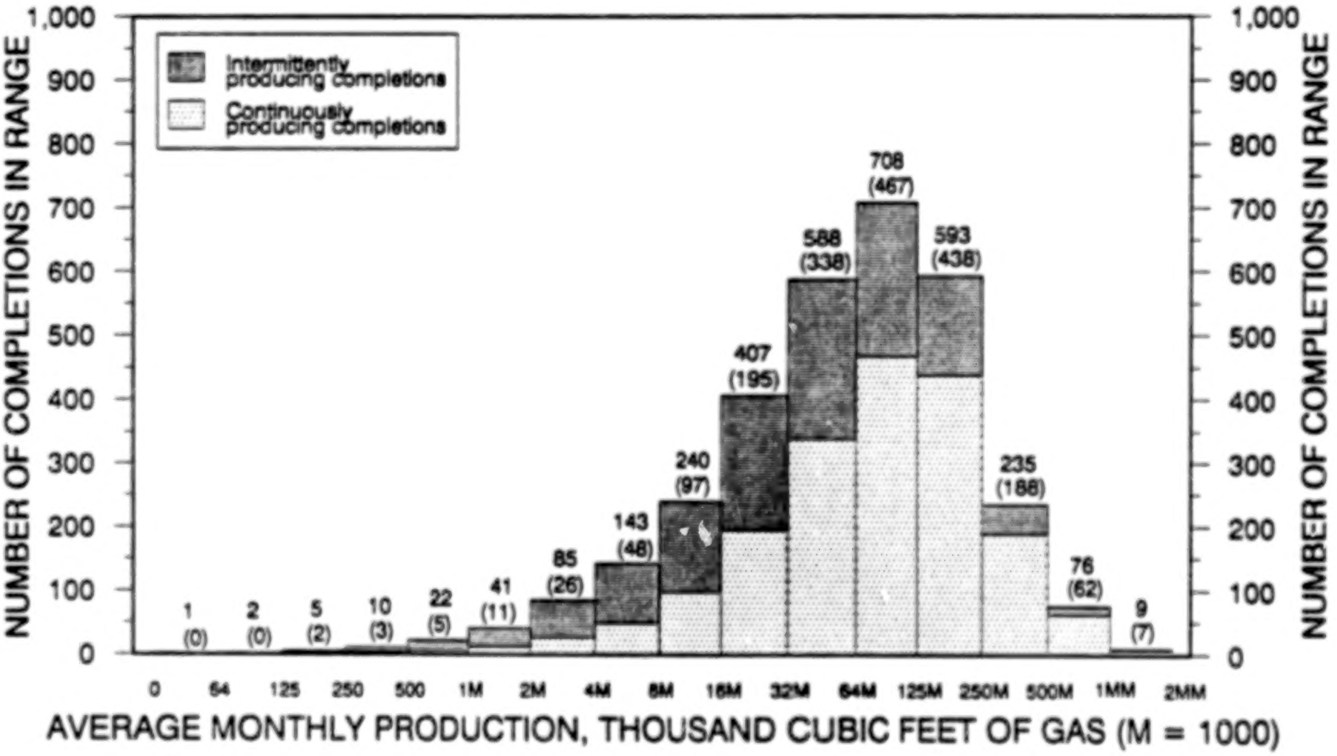


Figure 17.—Average monthly production distribution,
3,165 gas completions,
(1,887) continuously producing completions.

completions in that group, and the smaller value, shown in parentheses, represents the number of continuously producing completions.

Figure 16 shows the distribution of the 3,436 oil completions, with 2,196 completions on continuous production. There were 93 completions averaging more than 1,000 bbl per day of crude oil production. The median production rate is 2,837 bbl of oil per month, and the mean is 5,739 bbl per month. The leading oil producer was reported having produced in January 219,349 bbl of oil from a Pleistocene age reservoir with a subsea depth of 14,383 feet.

Figure 17 shows the rate of distribution of 3,165 gas completions with 1,887 gas completions on continuous production. There were 248 completions averaging more than 10 MMcf per day of gas production. The median production rate is 67 MMcf of gas per month, and the mean is 110 MMcf per month. The leading gas producer was reported having produced in December 1,935 MMcf of gas from a Pliocene age reservoir with a subsea depth of 10,480 feet.

Annual production since 1953 is shown in figure 18. The oil plot includes condensate, and the gas plot includes casinghead gas. Oil production reached a peak of 380 MMbbl per year in 1971 and then began an 8-year decline. Then in 1982 an increasing trend began and continued through March 1985. Since that date, the production trend has been decreasing. The 1989 annual oil and condensate production of 280 MMbbl is 7 percent

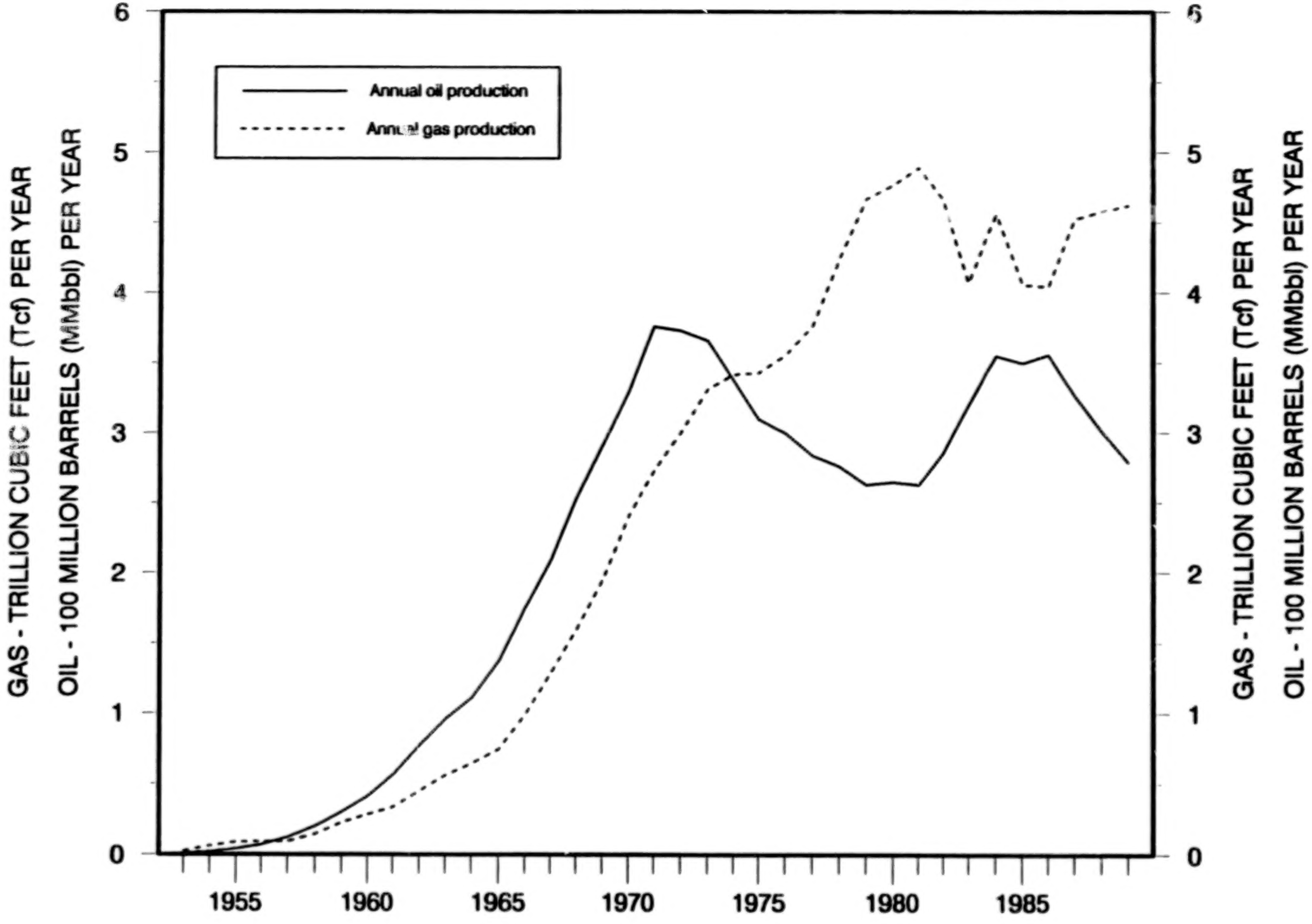


Figure 18.—Annual oil and gas production.

less than the 1988 production of 300 MMbbl. Annual gas production reached a peak of 4.9 trillion cubic feet (Tcf) in 1981. The 1989 gas production of 4.6 Tcf remains the same as last year and is 5 percent less than that of 1981.

Figures 19 through 22 show oil and gas reserves and production data classified by discovery date. The year of discovery assigned to a field is the year in which the first well encountering significant hydrocarbons in that field was drilled. This date may differ from the year in which the field discovery was announced. The total field reserves, as currently estimated, are allocated to the year of discovery and combined for plotting. As a field develops, the total field reserves as previously estimated may subsequently change. Changes will be reflected by new totals on the field's discovery date. Data for recent years are presented, but field development is insufficient to permit a lasting assessment of the reserves discovered in those years.

Figure 19 presents reserves discovered, cumulative production, and reserves remaining in billion BOE as of December 31, 1989, summed according to the year of field discovery. The degree of field depletion may be estimated by the relative positions of the cumulative production curves and the reserves-remaining curves. For example, if the value of the remaining reserves is higher than the value of cumulative production for a given year,

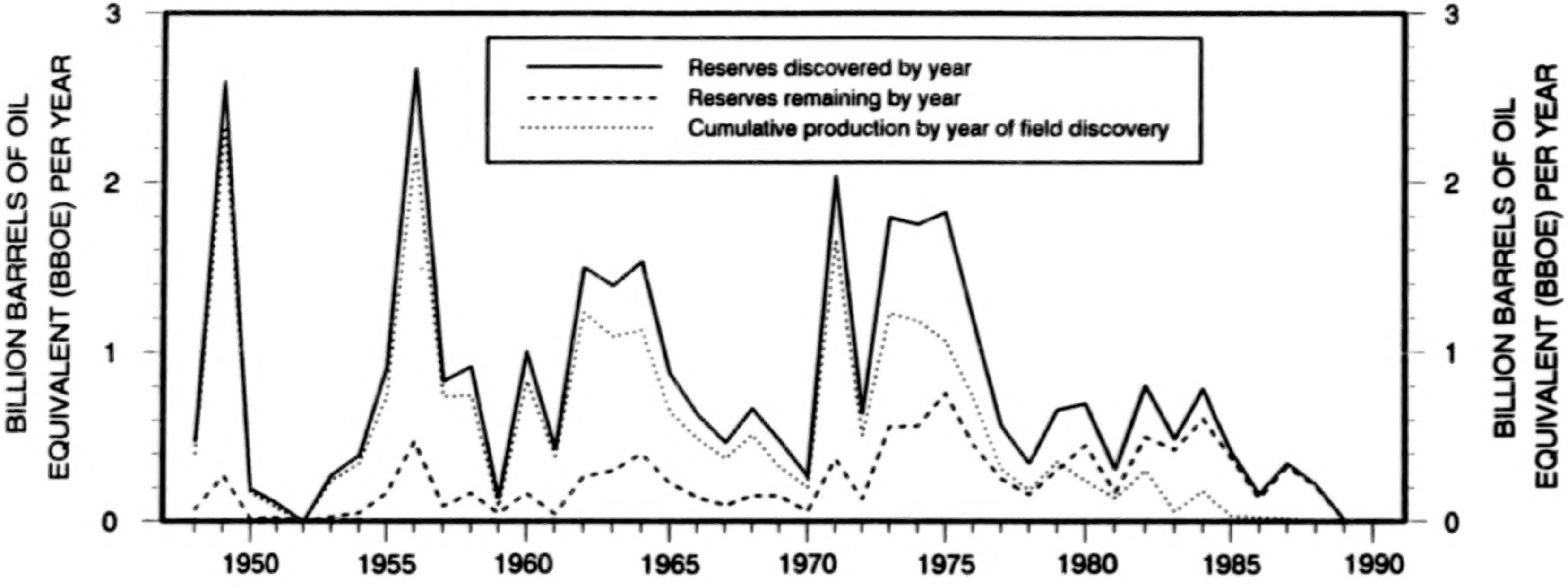


Figure 19.—Reserves and production by discovery year.

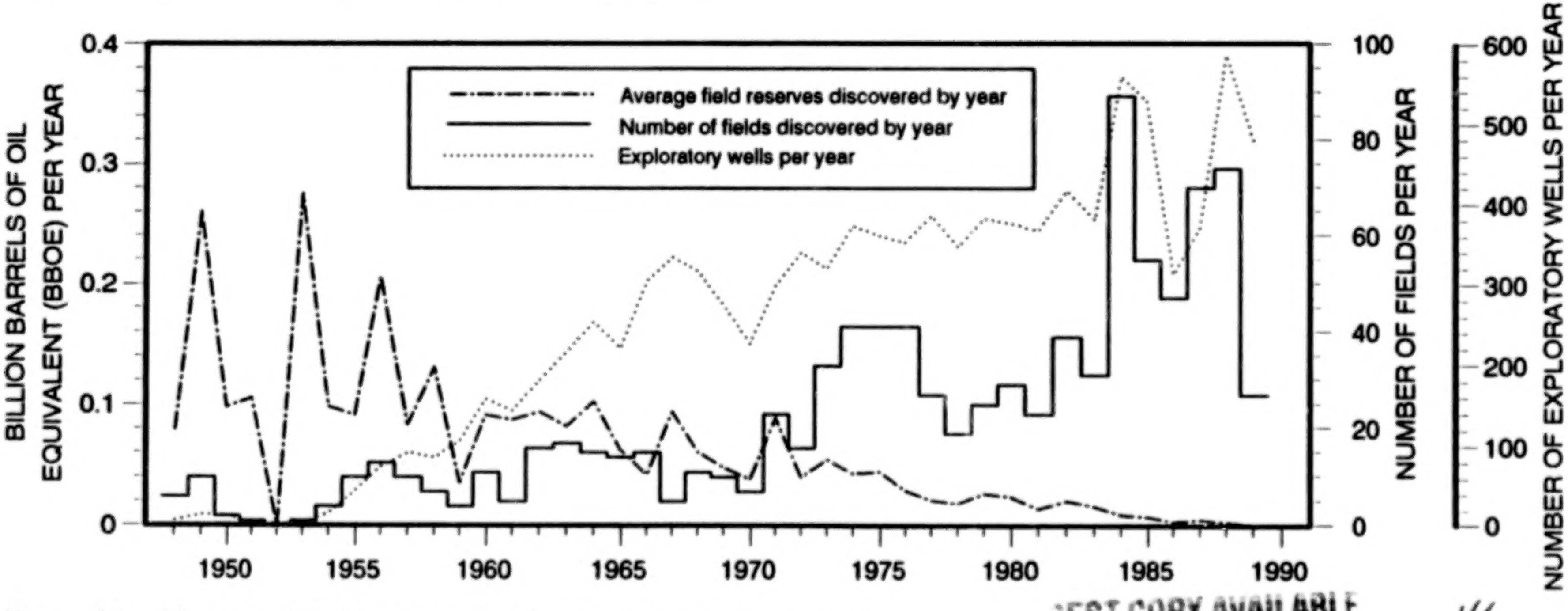


Figure 20.—Number of fields and average reserves by discovery year.

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the aggregate depletion for fields discovered that year is less than 50 percent. The plot demonstrates that fields discovered after 1979 are less than 50 percent depleted.

Figure 20 presents the number of fields discovered each year and the average discovery size in BOE of fields discovered each year. The plot demonstrates a trend toward decreasing average size of discoveries over the last 25 years. The number of fields discovered by year represents discovered resources that may be proved or unproved reserves. The average reserves discovered by year are based only on proved reserves. This restriction creates an artificially low value for the last few years for average reserves discovered by year.

Figures 21 and 22 show oil and gas reserves and annual production by discovery year. Superimposed on each plot of yearly discoveries is a line depicting the 7-year moving average, which better indicates the overall trend by smoothing out the peaks. The average presented is the total of the hydrocarbons discovered in a 7-year period divided by seven and plotted for each middle year. For comparison with the rate of discoveries, the annual production of oil and gas is also shown. The annual oil production (fig. 21) has equaled or exceeded the 7-year moving average of discoveries every year since 1969 except 1974. The annual gas production (fig. 22) exceeded the 7-year moving average of gas discoveries for the first

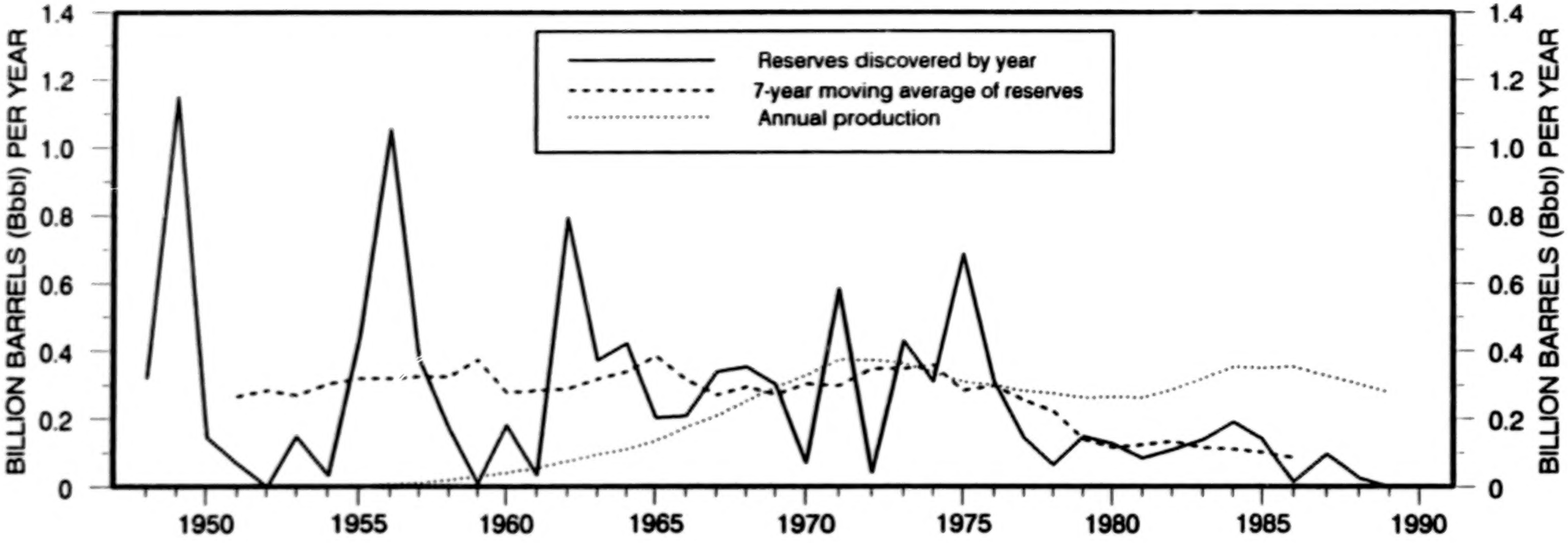

Figure 21.—Oil reserves discovered and oil production by discovery year.

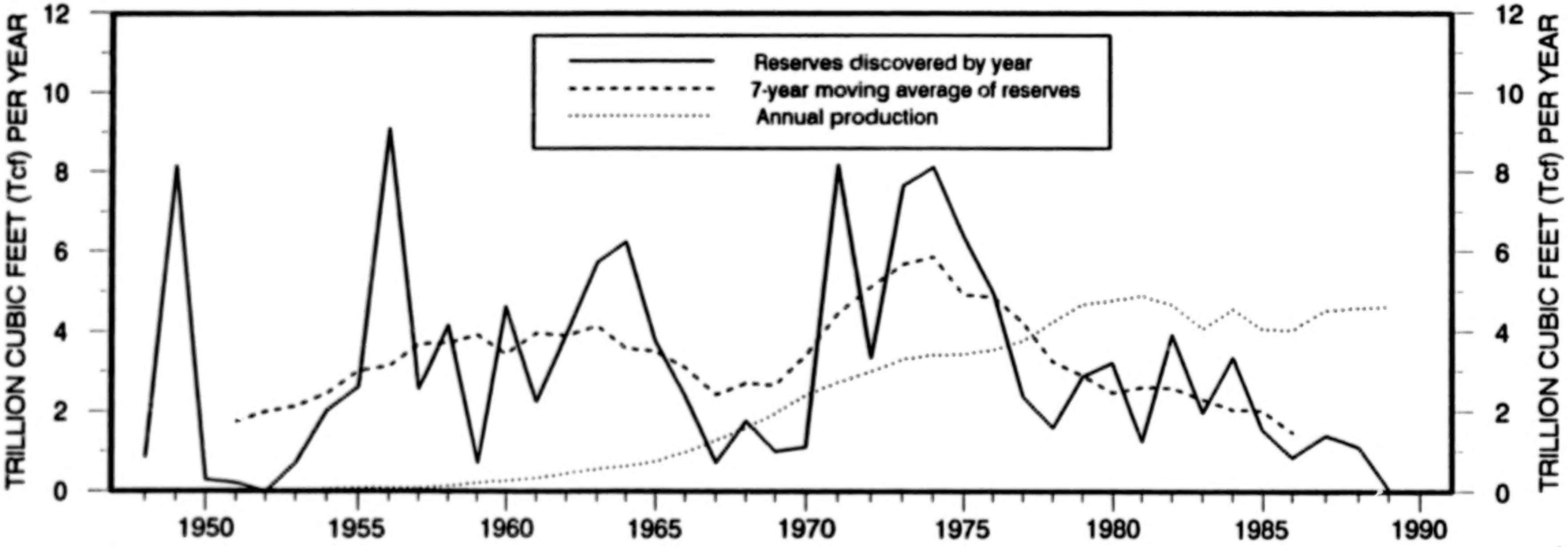

Figure 22.—Gas reserves discovered and gas production by discovery year.

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time in 1977. These two figures indicate that since the mid-1970's, new field discoveries have not provided enough reserves to offset annual production.

All data presented in figures 19 and 20 combine crude oil, condensate, associated gas, and nonassociated gas. All data presented in figure 21 include crude oil and condensate, and all data presented in figure 22 include associated and nonassociated gas.

New discoveries have accounted for increases in both oil and gas reserves compared to 1988. Based on periodic reviews of 104 field studies and recently adopted SPE criteria, estimates of reserves have decreased under revisions.

Figure 23 presents the number of exploratory and development wells and their total footage drilled each year. The plots indicate the current interest in exploration in the Gulf of Mexico by an overall increasing trend in exploratory drilling activity. Figure 24 presents the number of exploratory wells drilled each year by water depth. The plots show a large number of exploratory wells drilled in less than 200 ft of water, but exploration in the slope (greater than 600 ft of water) has increased in recent years with advances in technology.

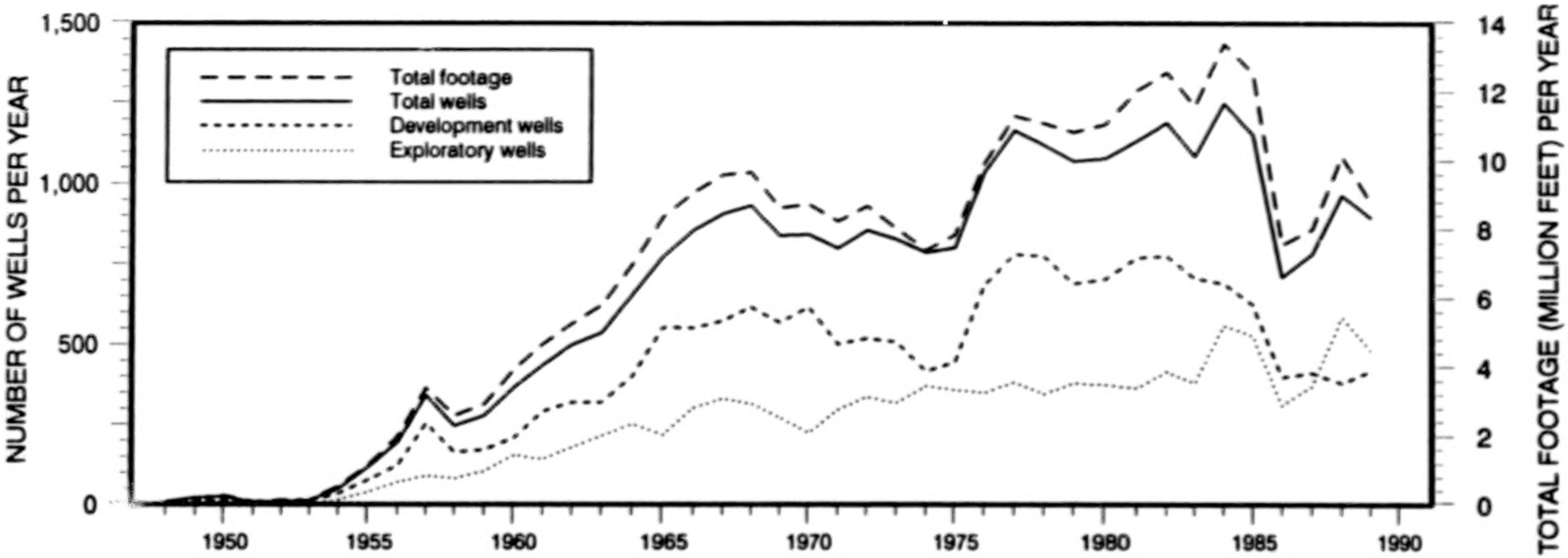

Figure 23.—Wells and footage drilled from 1948 to 1989.

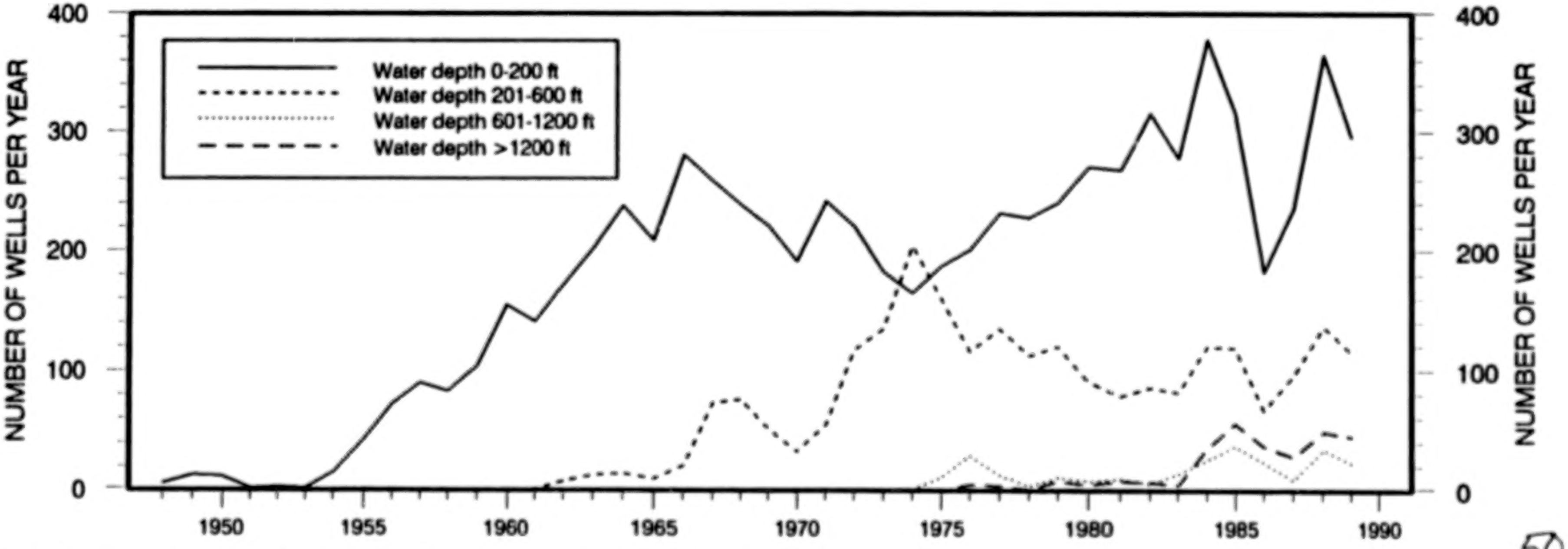

Figure 24.—Number of drilled exploratory wells by water depth.

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Summary

A summary of reserve estimate changes during the year and comparisons with the estimates as of December 31, 1988, are shown in table 5. The increase of original recoverable reserves resulting from new field discoveries (5 oil fields and 60 gas fields) is summarized and tabulated as changes to original recoverable reserves. For further clarification, new field discoveries are identified as new proved fields added in the last year, even though some were discovered before 1989. Reserve estimates are revised as needed, resulting in increases as additional wells are drilled and new leases are added to existing fields, and decreases as reservoirs are depleted and leases relinquished. Complete reevaluations of existing field studies are conducted as field development and production history indicate the need. Reserve figure increases and decreases are summarized and presented as changes due to revisions. The net results of these revisions are decreases in both oil and gas reserves.

Table 5 demonstrates that the 1989 oil discoveries, adjustments, and field revisions did not exceed production, resulting in a decrease of 0.36 billion barrels of remaining oil reserves. Discoveries, adjustments, and field revisions did not exceed gas production, resulting in a decrease in remaining gas reserves.

Table 6 presents all previous reserve estimates by year.

Table 5. — Summary and comparison of oil and gas reserves as of December 31, 1988, and December 31, 1989

	Oil (billion bbl)		Gas (trillion cu ft)	
Original recoverable reserves:				
Previous estimates, as of 12/31/88*		10.95		126.7
Discoveries	+0.16		+2.9	
Revisions	-0.24		-0.5	
Adjustments	0.00		0.0	
Net change		-0.08		+2.4
Estimate, as of 12/31/89 (this report)		10.87		129.1
Cumulative production:				
Through 1988*	7.56		84.3	
Adjustments		0.00		0.0
Through 1988 (corrected)		7.56		84.3
Production during 1989 (preliminary)		+0.28		+4.6
Through 1989 (this report)		7.84		88.9
Remaining recoverable reserves:				
Previous estimates, as of 12/31/88*		3.39		42.4
Discoveries	+0.16		+2.9	
Revisions	-0.24		-0.5	
Adjustments	0.00		0.0	
Production during 1989 (preliminary)	-0.28		-4.6	
Net change		-0.36		-2.2
Estimate, as of 12/31/89 (this report)		3.03		40.2

*Melancon and others, 1989

Table 6. — Oil and gas reserves and cumulative production at end of year, Gulf of Mexico, Outer Continental Shelf and Slope.

Oil expressed in billions of barrels; gas in trillions of cubic feet. "Oil" includes crude oil and condensate; "gas" includes associated and nonassociated gas. Remaining recoverable reserves estimated as of December 31 each year.

Year	Number of fields included	Original recoverable reserves		Cumulative production		Remaining recoverable reserves	
		Oil	Gas	Oil	Gas	Oil	Gas
1975	255	6.61	59.9	3.82	27.2	2.79	32.7
1976	306	6.86	65.5	4.12	30.8	2.74	34.7
1977	334	7.18	69.2	4.47	35.0	2.71	34.2
1978	385	7.52	76.2	4.76	39.0	2.76	37.2
1979*	417	7.71	82.2	4.83	44.2	2.88	38.0
1980	435	8.04	88.9	4.99	48.7	3.05	40.2
1981	461	8.17	93.4	5.27	53.6	2.90	39.8
1982	484	8.56	98.1	5.58	58.3	2.98	39.8
1983	521	9.31	106.2	5.90	62.5	3.41	43.7
1984	551	9.91	111.6	6.24	67.1	3.67	44.5
1985	575	10.63	116.7	6.58	71.1	4.05	45.6
1986	645	10.81	121.0	6.93	75.2	3.88	45.8
1987	704	10.76	122.1	7.26	79.7	3.50	42.4
1988†	678	10.95	126.7	7.56	84.3	3.39	42.4
1989	739	10.87	129.1	7.84	88.9	3.03	40.2

*Gas plant liquids dropped from reporting system.

†Basis of reserves changed from API demonstrated to SPE proved.

Conclusions

The 739 proved oil and gas fields in the federally regulated part of the Gulf of Mexico originally contained reserves estimated at 10.87 billion barrels of oil and 129.1 trillion cubic feet of gas. Remaining recoverable reserves, as of December 31, 1989, are estimated to be 3.03 billion barrels of oil and 40.2 trillion cubic feet of gas. These figures represent a 10.6 percent decrease in estimated remaining recoverable oil reserves and a 5.2 percent decrease in remaining recoverable gas reserves from last year's report.

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This report includes contributions from the following Gulf of Mexico OCS Regional Office, Resource Evaluation, Reserve Section personnel.

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Remaining recoverable reserves of oil* and gas in the Gulf of Mexico Outer Continental Shelf (OCS) have been estimated to be 3.03 billion barrels of oil and 40.2 trillion cubic feet of gas, as of December 31, 1989. These reserves are recoverable from 682 proved fields located in Federal waters. For any field contained partly in State waters and partly in Federal waters, reserves are estimated for the Federal portion only. An additional 114 fields have not been sufficiently developed to permit a reasonably accurate estimate of reserves. Original recoverable reserves are estimated to have been 10.87 billion barrels of oil and 129.1 trillion cubic feet of gas from 739 proved fields in the same geographic area. Included in this number are 57 fields that are depleted and abandoned; not included are the 114 insufficiently developed fields. Estimates were made for individual reservoirs based on geologic mapping and reserve evaluation of 522 fields. Preliminary geologic studies were conducted for the remaining 217 fields.

*The term "oil" as used in this report includes crude oil and condensate.

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